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BUILDING STONES
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RALPH W. STONE



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Building stones of
Pennsylvania

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PENNSYLVANIA
GEOLOGICAL SURVEY
FOURTH SERIES

BULLETIN M 15

BUILDING STONES
OF
PENNSYLVANIA

By
RALPH W. STONE

Department of Internal Affairs
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Harrisburg, Pa.

1932

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Washington Memorial Chapel, Valley Forge, built of granite gneiss from Holmesburg, Philadelphia County. Photo furnished by Holmesburg Granite Construction Co.

BUILDING STONES OF PENNSYLVANIA

BY RALPH W. STONE

INTRODUCTION.

More than once has the Geological Survey been asked for information about the character and quantity of stone to be had for building purposes in some specific part of the State and found that the only data were in the head or note books of a member of the Survey. What information has been printed on the subject is scattered in numerous reports, most of which are out of print, and was written at least 25 years ago. Any attempt to compile useful information on the building stone resources of Pennsylvania by the perusal of literature therefore is hopeless. Statements in the old reports as to the character of the stone are true, but otherwise they are of historical interest only.

The purpose of this report is admittedly economic, to satisfy requests for information as to where stone of a certain kind or for a specific purpose occurs or can be obtained, and to cite buildings in which the stone has been used, together with evidence as to its durability.

Because it seemed more convenient that way, the descriptions in this report are arranged by counties, rather than by kinds of stone. The information in these county descriptions was derived from two principal sources; the brief geologic description is based on a perusal of the geologic maps of the counties published by the Pennsylvania Second Geological Survey in Volume X, and the quarry notes and uses of stone in buildings are from my own note books.

During the past few years while traversing the State to keep in touch with the conditions of the non-metallie and non-fuel mineral industry, occasional notes have been made on the subject of building stone resources and use, and in the field seasons of 1928-1929 several weeks were devoted to this project. More field examination might be done, details of joint systems in quarries, and estimates of reserves might be made, thin sections of the rocks could be cut for microscope study, and blocks might be prepared for strength test, resistance to freezing and thawing, and durability of color, but if the data already accumulated are ever to be published, these other details must be omitted. Furthermore, I doubt if these refinements of detail would ever be used by architects, contractors or prospective builders. Persons unversed in petrography will not have enough interest in photomicrographs of thin sections of different kinds of rock to justify the expense of their preparation; and as for strength tests, any good building stone will support with a wide margin of safety any load put upon it.

In the earliest days of white settlement the first houses of course were built of logs, but it was not long until stone was used, and some of these early buildings still stand. The Caleb Pusey house in Up-land, Delaware County, a little one-story stone structure, was built



Fig. 1. Caleb Pusey house, Upland, Delaware County. Built in 1683 of local field stone.

in 1683, the year after William Penn landed. Wynnstay, the stone house at 52d and Woodbine Avenue in Germantown was begun in 1689, and Wyck at Germantown Road and Walnut Lane in 1690. A two-story stone prison in Philadelphia took shape in 1723 and the Chester County Court House in 1724. Elderly but not so old are Grumblethorpe at 5261 Germantown Road, built in 1747 and two stone houses in Fairmont Park, Philadelphia, dating from 1761.



Fig. 2. St. David's Church, 1 mile south of Wayne, Delaware County. Built of granite gneiss field stone in 1715.

Places of worship also were constructed of enduring stone and are used for the same purpose today, after more than 200 years of service, as St. Davids Church, Radnor, built in 1715 and Radnor Friends Meeting House, 1718. Paxtang Presbyterian Church (1740) near Harrisburg is in the same class.

The progress of settlement away from tidewater is marked and dated by stone buildings still standing, as the Daniel Boone (1730) and Modesai Lincoln (1733) houses near Birdsboro, and Zellers Fort (1745) near Sheridan, Lebanon County. John Harris' mansion house at Harrisburg dates from 1766, and some of the stone farm houses in the Cumberland Valley are nearly as old.

The early settlers seem to have been an industrious lot, for they either had the time and energy to do the work themselves or money to hire labor, and undertook tasks at which individuals today would hesitate. The pioneer farmer quarried the stone himself, hauled it to his building site, and laid it into walls with mortar made from lime which he had burned. He built for himself and his children, but some of his houses have survived six or seven generations and the masonry apparently is still good for centuries to come.

KINDS OF STONE AVAILABLE.

There is no scarcity in the variety of stone in Pennsylvania available for building purposes. At least eleven distinctly different kinds are in use: granite, gneiss, schist, trap, serpentine, lava, limestone, marble, sandstone, quartzite, and slate.

Granite is limited to small areas in the southeastern part of the State, gneiss and schist are more widely distributed in that area, and trap is confined almost exclusively to the belt of Triassic sediments extending from Easton to Gettysburg. Serpentine occurs mainly in Philadelphia, Montgomery, Delaware, Chester, and Lancaster counties, and lava in the South Mountains, particularly west of the Susquehanna. Limestone and sandstone are produced from one end of the State to the other, quartzite is widely distributed, marble occurs in the Chester and Cumberland valleys, and slate in Northampton and Lehigh counties, and in southern York and Lancaster counties.

GRANITE.

Most people who know rocks at all can distinguish granite, sandstone, and limestone although they might not be able to tell off-hand what the characteristics are by which they recognize each. Briefly, granite is a granular igneous rock composed essentially of quartz, orthoclase or microcline, and mica. Commonly a part of the feldspar is plagioclase, and the mica may be either biotite or muscovite or both. To one not familiar with minerals this description means less than to say granite is a rock made of large or small grains or both, compactly grown together, reflecting light from the crystal faces, and containing much more white, gray, or reddish mineral than black. It has no banding or linear arrangement of the minerals, it has no bedding planes, or parallel cleavage lines, and may be used in large blocks. Its use for grave markers in cemeteries is outstripping that of marble in many regions.

GNEISS.

Gneiss is a crystalline rock that has the same mineral composition as granite, and looks like granite, but the minerals have a more or less

well-developed parallel arrangement, so that the dark minerals make noticeable black bands. There are several varieties of gneiss, named for the most prominent silicate. Gneiss differs from schist in the coarseness of the lamination, and by insensible gradations passes into schist.

Gneiss is used like granite for building purposes, curbing, paving blocks, etc., and in some quarries very large blocks can be produced on demand.

SCHIST.

Schist is a rock composed mostly of quartz and mica arranged in parallel laminae or layers. If by variation the laminae become coarse and quartz predominates, the rock is called gneiss. Variation in the other direction, to very thin layers and mostly mica, becomes mica-schist. Schist tends to split in slabs, parallel to the laminae, and usually is rather soft, but as its component minerals are resistant to solution or alteration the rock is durable when protected from moisture and freezing.

Schist is a metamorphic rock produced by the alteration of either sedimentary or igneous rocks. It has a foliated or parallel structure generally produced by shearing and recrystallization under pressure. It is named from the principal mineral, the commonest type in Pennsylvania being mica-schist. Mica-schists are the result of thorough alteration or recrystallization of sandstones, shales and clays, and also from the crushing and excessive shearing of granite and other igneous rocks.

TRAP.

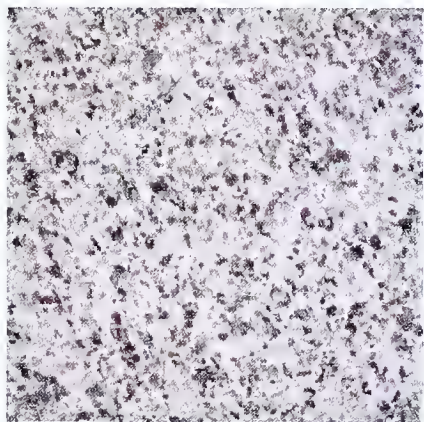
Most people in southeastern Pennsylvania who recognize more than three kinds of rock know trap. If not by that general term, they know it as iron stone, black granite, or the rock that makes "nigger-heads." It occurs abundantly as an intrusive in the Triassic red beds from near Bethlehem to Gettysburg. This rock is generally recognized by its fine grain, black color on fresh fracture, gray on the weathered surface, and the rusty brown of fragments occurring in the soil. It tends to weather in rounded forms.

Trap is a general term for dark fine-grained igneous rocks. It is a Swedish name from the occurrence of such rocks in sheets that resemble steps, "trappar."

Although various rocks are known as trap, the word as applied to rock in southeastern Pennsylvania refers to diabase, a dark rock whose principal minerals are greenish-black pyroxene and white or grayish plagioclase feldspar. In the large masses of diabase where crystallization is coarse enough so that the individual minerals can be seen with the naked eye, the characteristic texture of diabase is seen. The feldspars are lath-shaped and the dark minerals fill the interstices. Diabase in narrow sills and dikes may be so fine-grained, especially at the contact, that the crystalline character is hard to detect, even with a lens.

SERPENTINE.

Serpentine is a metamorphic rock composed chiefly of the mineral serpentine. It is a light-green to dark-green granular rock that is somewhat resistant to weathering because of the insoluble character of its principal component mineral. Although comparatively soft its topographic expression nevertheless is as a low ridge. Serpentine in southeastern Pennsylvania is derived from an original intrusive rock.



A



D



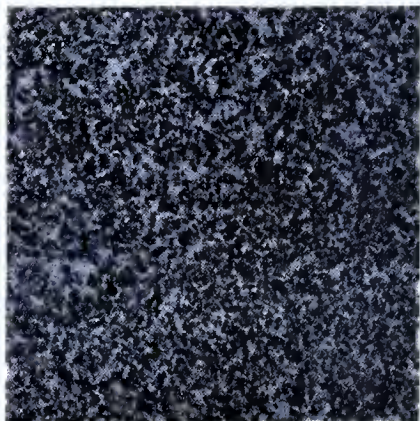
B



E



C



F

- A. Granite from Seisholtzville, Berks Co.
- B. Granite gneiss from Morton, Delaware Co.
- C. Mica schist from Broomall, Delaware Co.
- D. E. "Black granite" (diabase) from Bucks Co.,
near Coopersburg.
- F. "Black granite" (diabase) from Saint Peters, Chester Co.



A



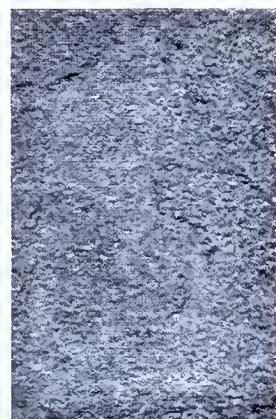
B



C



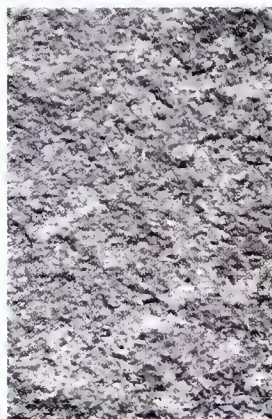
D



E



F



G

- A. Sandstone from Waynesburg, Greene Co.
- B. Sandstone from Koppel, Beaver Co.
- C. Sandstone from Kittatinny Mountain, Berks Co.
- D. Sandstone from Curwensville, Clearfield Co.
- E. F. G. Flagstone from Meshoppen, Wyoming Co.

When used as building stone, the color may remain a fresh green if the building is in the country or where the atmosphere is not contaminated. In cities, however, or any location where the air is polluted with acids, such as sulphuric acid from the fumes of coal combustion, the serpentine is likely to change color and to disintegrate.

LAVA.

The fluid or molten outpouring of a volcano when cooled and solidified usually becomes porous rock and is known as lava. Some of the oldest rocks in Pennsylvania are altered lavas in South Mountain between Adams and Franklin counties. These metamorphosed lavas, metabasalt and metarhyolite, are dark and light colored, respectively, and some have a considerable variety of color. The prevailing color of the metarhyolite is bluish-purple to blue-gray and the metabasalt is prevailing a greenstone. They are fine-grained, fairly resistant to weathering, and break with a hackly fracture.

LIMESTONE AND DOLOMITE.

A Boy Scout once told me that he could distinguish limestone from sandstone because it is lighter colored. This is not correct, however, because some sandstone is white and some limestone is black. Limestone is a sedimentary rock formed in layers on the bottom of the ocean or other large body of water and composed primarily of calcium carbonate. There is every gradation from limestone with only a trace of magnesium carbonate to dolomite, which is a sedimentary rock made up mostly of magnesium carbonate. Limestone is usually not so hard as sandstone; at least it can be scratched with a knife. Its texture may be coarse, when composed of fragments of fossil shells lightly cemented together, or it may be so fine-grained that the naked eye cannot detect individual particles.

Pure limestone or dolomite should be perfectly white, but impurities give these rocks more or less color. Iron oxides produce shades of buff, yellow, pink, and red; and carbonaceous matter makes limestone blue, gray, and even black. The iron oxide colors are permanent but those due to carbonaceous matter will fade when exposed to the atmosphere. Some limestone that is dark blue when freshly quarried may in the course of a few years exposure become light gray.

MARBLE.

To most people marble is a white stone much used for grave markers; to Philadelphians it is the white stone used for door steps. In the trade, however, color is no criterion and marble is any calcareous rock that will take a good polish and is suitable for carving, ornamental work, and interior and exterior construction. True marble is an aggregate of calcite and dolomite grains, mostly calcite; the grains or crystals are usually of uniform size in the same marble, although they may vary widely between different marbles. Marble is different colors, black as well as white, chocolate, green and yellow. For use in building construction it must quarry in large blocks, and for most commercial use it must be free from cracks and impurities.

Most of the marble quarried in Pennsylvania is white, white streaked or clouded with blue, or blue-white. It was produced somewhat extensively 50-75 years ago or before the Vermont marble reached eastern Pennsylvania in quantity. The quarries were in rocks of Cambrian age in Chester Valley and of Algonkian age (Cockeys-

ville marble) near West Grove. Marble has been found also in a few places in the Great Valley from Lehigh County to Franklin County.

Marble is the result of physical and chemical changes in limestone. Pressure and heat, solution and recrystallization have greatly altered the original limestone which doubtless was composed of the limy skeletons of many forms of marine life. All these forms extracted lime from sea water, built it into their solid structures, and on dying contributed it to the accumulation on the sea floor. In the course of ages these skeletons, compacted into a solid mass, became limestone, which later was changed to marble. In the metamorphism all trace of organic forms or fossils in Pennsylvania marbles was lost.

SANDSTONE.

Sandstone, as the name implies, is a rock composed of sand. Sand is mineral grains smaller than pebbles, and may be all one kind or a variety of minerals. Sand is the result of rock decay or disintegration. The breaking up of granite by the action of the elements reduces it to grains of quartz, mica, hornblende, feldspar, etc. The hornblende slowly alters to iron oxide, the feldspar to clay, and the quartz being practically insoluble and indestructible is left in angular grains which gradually become rounded as they are transported by running water. These products of decay are carried by streams to lakes or to the ocean and there deposited, the fine material being carried farther from shore than the coarse grains or pebbles. As running water sorts its burden by size and weight of grains or particles, the fine silt is laid down as mud farther from shore than the sand; gravel is dropped wherever the current slackens. With proper conditions of sedimentation, the separation may be well-nigh perfect and sand of remarkably uniform grain size may accumulate over a large area of sea bottom. When cemented it becomes sandstone.

Sandstone differs according to size and shape of grain, component minerals, cementing material, and so as to coarseness, solubility, porosity, color, hardness, etc. Some sandstones are so fine-grained that their sandy character is recognized with difficulty, others are very coarse and those that contain pebbles are called conglomerate. Sandstone may be composed wholly of quartz grains, or of a mixture which usually includes feldspar, mica, hornblende and other components of igneous rocks. If much feldspar is present the rock is called arkose. Arkose usually is composed of more or less angular grains, because feldspar disintegrates more readily than quartz and if the grains have been subjected to so much weathering and abrasion that the quartz grains are rounded, then it is likely that the feldspar will have been completely disintegrated. By the same token pure silica sand is composed of well-rounded grains, for it is derived by the disintegration and reworking of older rocks, in which process the less stable minerals have been broken up and washed away.

Grains of sand are made into hard rock by pressure and cementation. Calcite, quartz, limonite, and clay may one or all be the binding material that holds the grains together. Iron in the cement gives color to sandstones.

Bluestone is the commercial name for a dark bluish-gray feldspathic sandstone that is quarried extensively in Wayne, Susquehanna, and adjoining counties for flagstone and curbstone. The color is due to

the presence of fine black and dark-green minerals. Slight metamorphism makes it tough.

QUARTZITE.

Quartzite is a silica sandstone which has been altered by the deposition of secondary silica between the original grains, so that the rock is more firmly cemented and less porous than before. Usually it is closely jointed and hard to work into regular shapes, so that it is more commonly employed for road metal. Quartzite of course is much harder than most sandstones, and has a distinctive grain. It has a fairly pronounced crystalline character, owing to the abundance of crystalline quartz that cements together the grains of the original sandstone.

Ganister is the term applied in Pennsylvania to any high-silica rock used in the manufacture of silica brick or for lining metallurgical furnaces. As large quantities of ganister are taken from the rock floes on the steep mountain flanks in central Pennsylvania for use as refractories, the word has come into fairly common use for any rock on these floes, and is used indiscriminately for quartzite.

SLATE.

Although slate is rarely used as building stone, nevertheless it is considered here because in the immediate vicinity of quarries it has been so used, and it finds minor application as steps and sills, to say nothing of roofs.

Slate is typified by its fine texture and cleavability into thin slabs. As sandstone is converted into quartzite by resiliification, so clay and shale or mudstone are converted into slate by pressure. In view of the fact that the feature which distinguishes slate from a hard, tough shale is the possession of a cleavage that may lie at any angle with the original bedding of the rock, we may look upon slate as a rock of more than common interest. The conversion of a mudstone with bedding planes to a tough slate that breaks in planes across the bedding and has new minerals developed in it is no mean undertaking. Physically the alteration consists of an intense compacting of the rock matter, with the development of minerals in thin flakes rather than grains. Incidentally granular minerals are sheared or pulverized. The dynamic strains that produced these effects also produced shearing stress and some slight movement. In fact, the force producing the change was so great that the component grains in the shale were flattened in the slate and lie parallel with the new cleavage.

If the pressure and heat that accompanied it were long enough continued or intense enough, the slate would be converted into phyllite and mica schist.

USES.

Some of the uses of stone are for the foundations and walls of buildings of all sorts, for bridges and culverts, for curbing, pavements, well covers and lining, for window and door sills and lintels, doorsteps and staircases, monuments, retaining walls, fences, breakwaters.

BUILDING STONE.

The principal use of course is in the walls of buildings. In the olden days a stone house had solid stone walls, nowadays the walls of many buildings are cinder blocks, brick, or concrete and steel, and

the stone is used merely as a protective and decorative shell. Even so this illustrates the belief in the superiority of natural stone.

Long before Columbus discovered this continent the Mayas in Mexico and Yucatan had built imposing structures of dressed and carved stone, and the Indian cliff dwellers of our own Southwest lived in stone houses. From that day to this, man has built for permanence, and if not his whole house, at least his cellar wall has been built of enduring material, preferably stone.

Cellar walls and many buildings are laid up with rubble. This leads to a few definitions. Rubble is the term for rough stones of irregular shapes and sizes, that have been broken from larger masses either naturally or artificially. Naturally rubble makes a more or less rough wall in which the stones have little semblance of linear arrangement, that is, they are not in regular parallel courses. In masonry rubble refers to this rough, uncoursed work and to the filling between or "backing" behind outer courses of squared stone.

Squared blocks of stone are called ashlar. If the blocks are all the same thickness it naturally results that they are laid in parallel courses. This type of masonry is called coursed ashlar. When the blocks are of different thicknesses a semblance of parallel courses may be had but is not continuous and the resulting masonry is called randon or broken ashlar. See Figure 3.



Fig. 3. Wissahickon gneiss in High School, Lansdowne, Delaware County. Shows coarse-grained augen gneiss from McVaugh quarry, Media.

When the exposed face of a block is dressed smooth, it is called plane ashlar, and when left rough, it is rock-face ashlar; tooled proper when tooled in parallel grooves and random tooled when the cuts are irregular. When dressed with a pointed hammer the face is "nigged."

In residences it is customary to use only one kind of stone, unless for structural reasons or improvement in appearance, another kind is used for trim, that is, for window and door sills and lintels, water tables, and corner quoins. In larger buildings and banks it is common practice to use a dark stone for the base courses, or exposed part of the foundation, and lighter stone for the walls. Polished, coarse-grained granite for the base and light sandstone or limestone above is a combination frequently employed for banks.

Building stones have a wide range in size and shape. Mica schist, slate, and bluestone naturally split in thin slabs; rarely, I believe, can limestone be produced in this State in blocks more than 2 feet thick and most of this stone used for building is less than 10 inches thick; on the other hand, sandstone, granite, marble, and trap can be produced in some quarries in blocks of a size and weight up to the capacity of a crane to lift or a truck to carry. Some sandstone quarries can produce nothing but flags, some yield an abundance of block 6 to 10 inches thick just right for common building purposes, and other quarries because of the thickness of the layers make a specialty of large blocks, 20 to 30 cubic feet each, for the heavy masonry in railroad bridges and retaining walls and the massive foundations of large buildings.



Fig. 4. Schistose phase of Wissahickon gneiss in Drexel Hill Title & Trust Company building, Garrettsford, Delaware County showing bias edges produced by joints. Larger blocks are set on edge.

Very different effects may be produced by different treatments of the same stone. If mica schist is laid flat with all edges rough, the tone will be dark. If an occasional stone is turned on edge so that flat faces of mica flakes are exposed the tone is lightened. Tool-dressing the edges also lightens the tone. (See Figure 4.)



Fig. 5. Triassic sandstone in Court House, Lancaster. Set in 1854, sand blasted in 1929. Shows effective use as coursed ashlar.

The contrast between sandstone dressed to a smooth face and a rock-face job is shown in accompanying illustrations, and also the difference between quartzite and a coarse-grained gneiss, both laid as random or broken ashlar. Details of serpentine masonry, both ashlar and rubble are illustrated in the chapter on Chester County. Close-ups of limestone and brownstone will be found in other chapters.



Fig. 6. Carboniferous sandstone in Court House, Uniontown, built in 1890. Used as rock-face random ashlar.

CURBSTONE.

Paved streets in cities and towns are lined with curbing, and even unpaved streets in some villages are thus outlined. In many cities the curbing set in the last quarter century is mostly concrete except where the property owners were willing to pay the difference for natural stone. The natural stone used in this State for curbing includes granite, gneiss, quartzite, sandstone, bluestone, browstone, limestone and slate.

Granite from Seisholtsville, Berks County, and granite-gneiss from Holmesburg and Swarthmore make excellent and durable curbing. A red quartzite quarried at White Haven and Lehigh Tannery on Lehigh River is worked into curbing for the cities in the Lackawanna Valley. The Homewood and other massive sandstones in the western part of the State are used very extensively in the Pittsburgh district. Large quantities of curbing are cut from massive sandstone at Curwensville in Clearfield County, at Wurtzburg and Koppel in Beaver County.



Fig. 7. Curbstone made from Homewood sandstone at Koppel, Beaver County.

In the northeast part of the State where bluestone is raised for flagging, some of the heavier stock is made into curbstone and experience of many years has shown the well-selected stone to be durable.

Limestone is less commonly used for curbing and then mostly in the towns near the limestone quarries, for reasons of economy. The limestone in the eastern part of the State is difficult to dress into smooth curbstone, but the massive siliceous limestone in Fayette and Westmoreland counties works better and abrades less easily. In the slate region some of the tough sandy beds have been worked into curbstone.

Curbstone is usually 18 to 24 inches deep, 4 to 6 inches thick, and random length. Some that has been in place for half a century is still in good condition. Natural stone curbing generally does not break so easily as concrete, and yet some towns have replaced the natural with the artificial.

FLAGSTONE.

The broad thin flags used for sidewalks are mentioned here because they are coming more and more into building construction. For many decades they have made the sidewalks of village streets, especially in front of the stores, and until concrete became so widely used, flags



Fig. 8. Bluestone flag at 514 Church Street, Honesdale, Wayne County. Measures 22' 3" by 7' 11" by 4".



Fig. 9. Bluestone flags in Swarthmore College cloister. Photo from Ridgway & Son, by Bond Bros., Philadelphia.

were the common city pavement. From the same quarries, bluestone was taken for sills, lintels, and doorsteps, and an occasional building where many people congregated had a flag floor in the main room.

In recent years flags have been used for paving terraces and patios, for garden paths, steps, and benches, for porch and interior floors, and lastly the $\frac{1}{2}$ -inch flags are now being used to shingle roofs and for tile in walls and interior floors. Flagstone is now used occasionally for floors in dining halls, libraries, and other rooms in college and public buildings, either in large flags or in blocks one foot square and one inch thick. Also heavy stock from flagstone quarries has been used for interior staircases and landings in public buildings. So flags may now properly be included as a building stone. In fact, in the northeast part of Pennsylvania where most of the flagstone quarries are located, one sees retaining walls and foundations built of flagstone, and an occasional house in which heavy stock from a flagstone quarry is the principal building material.

PAVING BLOCKS.

For paving streets where traffic is very heavy or where traction for horses feet or rubber tires must be good, blocks of tough stone may be used. These blocks usually are not smaller than 4 by 6 by 8 inches, and are wrought by hand. Paving blocks have been made from diabase or trap at St. Peters, Chester County and Shelly, Bucks County; from granite gneiss at Holmesburg, Philadelphia County and quartzite at Lehigh Tannery, Carbon County. In the western part of the State paving blocks have been made from sandstone near Ellwood City, Lawrence County, and from siliceous limestone at Bakers Station and other places in Westmoreland County.



Fig. 10. Paving block made from Mauch Chunk sandstone, Lehigh Tannery, Carbon County.

SLATE.

Pennsylvania slate is black or blue-black and so too dark for building stone; nevertheless in the slate region, house foundations were built of slate rubble before poured concrete walls and concrete blocks became so common. I believe too that one might find a few houses that are built of the discarded sandy beds or refuse from the slate quarries.

Slate is a common roofing material, and less commonly used for stair treads and risers, floor tile, sidewalks, and curbs. Ripply surfaced, irregular slabs of slate set in concrete are used sometimes for interior floors where foot traffic is heavy. Its use for billiard table tops, vaults, shower stalls, electric switch boards, panels, partitions, etc. is well known. Near Bangor are posts for rail fences made of slate.

CHARACTER.

HARDNESS.

Some rocks of the same mineral composition are hard and others are soft. The Oriskany sandstone used so abundantly in this State for making glass sand is composed in some places of pure quartz grains so loosely held together that the stone can be crumbled in the hand. This stone is soft. Elsewhere, even in the same quarry, the individual quartz grains composing the Oriskany sandstone are so tightly cemented with secondary quartz that the rock is difficult to break with a sledge. In this case the hardness of the rock depends on the state of aggregation.

The hardness may depend on the mineral composition. A stone composed wholly of quartz, one of the hardest of minerals, is naturally harder than one composed wholly of calcite or gypsum than can easily be scratched, provided the state of aggregation is similar. The presence or absence of a cementing material and the character of cement also affect the hardness, for the cementing material will have a hardness of its own and raise or lower the hardness of the rock in which it acts as binder. In igneous rocks the relative abundance of the different minerals is a major factor in determining the hardness. In rocks of the same grain size and similar aggregation, it is natural that the one having a high percentage of feldspar or mica is softer than the one consisting largely of quartz.

Hardness is of importance in selecting stone for floors, walks, door sills and other places subject to much wear. Flagstone with hard knots in it is likely to wear rough, and a door sill of soft stone is bound in time to become hollow. For this reason, mica schist, though very durable when used in the walls of a building, is rarely placed where it would be abraded.

COLOR.

The color of a rock is a composite of the colors of the different minerals of which the rock is composed. Furthermore, the color of freshly quarried rock changes as the rock seasons. The evaporation of interstitial water may change a rock from blue to white. The

color of pure quartz sand is white, but most sandstones contain some iron and carbonaceous matter. The iron gives a buff, tan, brown, or reddish color and the carbonaceous matter makes the rock gray, blue, or black. Granite is composed of white or colorless quartz, of feldspar, and mica or hornblende. If the feldspar and mica are white, the color of the rock is white, but black mica or hornblende gives granite a gray color. If these minerals are not abundant and the feldspar is strongly colored the granite may be pink or red.

The color of a rock within the zone of weathering is likely to be different from the rock at depth. The usual difference in granite and sandstone is that the rock near the surface is bleached lighter or it is stained or rusty with iron. This discoloration is a natural result of the exposure of iron sulphide or carbonate to the atmosphere.

Limestone ranges in color all the way from white through blue to black, depending usually on the amount of carbonaceous material, but on exposure some limestone becomes yellow or pink with iron stain, or dark blue limestone may by long exposure become light gray, due to bleaching of the carbonaceous material. Sandstone in the Coal Measures contains more or less feldspar and traces of iron, and commonly weathers to a greenish tan or light olive color.

The red color of the Triassic rocks, and of the Mauch Chunk and Catskill beds is pronounced. Some building stone is called brownstone from its color. Likewise the flagstone quarried in northeast Pennsylvania is called bluestone although the blue is barely perceptible and much of the stone has a green or mauve tint rather than blue. These colors are strong enough so that patterns can be made in floors, using natural color flagstone.

The permanence of color depends on the constituents of the stone, and on atmospheric conditions. Some iron-bearing minerals break down quicker than others and stain the matrix within a few months or years. In thickly settled communities using coal for fuel, the atmosphere contains enough acid to hasten the disintegration of some stones. At least the pale yellow of some serpentine buildings has been ascribed tentatively to the polluted air.

In communities where large quantities of soft coal smoke are discharged into the air most building stone in a few years of exposure becomes coated with a film of soot that eventually is dead black. This soot adheres particularly to the more prominent relief of rock-faced blocks, and perhaps most strongly to the stone that is porous and by capillary moisture holds the soot in place.

This being the case, the original color of a building stone is of little importance, especially in a place like down-town Pittsburgh, for in a few years at most it will be masked by soot. Of course such discoloration can be removed by sand-blast or other methods of cleaning. A smooth-dressed stone catches soot less readily than a rock-faced one and so stays clean longer.

TEXTURE.

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The texture of a rock is determined by the size, arrangement, and means of binding the fragments or crystals that compose it. A glassy texture in which individual particles cannot be distinguished by the unaided eye is easily distinguished from crystalline texture which ranges from fine to coarse and is well exhibited in granite monuments. Some granite is of such small grains that the texture

is like pepper and salt, and some is so coarse that occasional crystals are half an inch or more in diameter. In many crystalline rocks the grains are so closely grown together that there are few if any voids between them. In other words, the rock is dense and has no pore space. Some igneous rocks on the other hand, especially lavas poured out on the surface, have a glassy texture but are made very porous by gas bubbles.

Fragmental or elastic rocks, formed from the fragments of other rocks, are variable in texture from fine to coarse grain and also in porosity. These include sandstone, conglomerate, and breccia. All gradations exist between fine even-grained sandstone and coarse conglomerate in which gravel and cobbles several inches in diameter are bound together in a sand matrix. Shale and limestone usually are fine-grained, dense rock but some limestones are coarsely crystalline. Pore space between the fragments of a elastic rock permits the entrance of moisture which, if slightly acid, may dissolve the rock; or if the water freezes may disrupt the rock. Texture and porosity therefore have something to do with the durability of a rock. A dense rock which does not dissolve readily is likely therefore to be more durable than a coarse-grained and porous rock.

In rocks of unequal grain, such as porphyries and conglomerate, it frequently happens that the coarse grains are resistant to weather and expand or contract unequally under the influence of heat and cold, and thereby the surrounding finer grained matrix is loosened and the larger particles are released, or stand out as knobs.

The texture of sedimentary rocks may vary from bed to bed, and also along the bedding. The texture of a elastic rock is influenced somewhat also by the presence or absence of cementing material. Lightly compacted sandstone may be held together only by adhesion between the grains and be rather porous; another sandstone of similar grain size may have all the spaces between the grains filled with secondary quartz, thus giving it a tight texture.

STRUCTURE.

Most building stones show some structure, as original bedding planes, schistosity, cleavage, or joints. It is along these lines of weakness that the rocks break most easily, and their abundance and character may be important factors in the selection or use of building stone. Where bedding planes are far apart, thick blocks can be raised, and where they are close together only slabs can be taken. The distance between joints may determine the length and size of blocks or slabs.

If joints are at right angles to each other and perpendicular to the bedding the production of rectangular building blocks is greatly facilitated. In some quarries, especially in quartzite, the small joints often are at other angles than vertical to the bedding and blocks taken from such beds have oblique rather than square ends.

STRENGTH.

To make a strength test it is customary to cut out samples in 1- or 2-inch cubes or drill out a cylinder 1 inch in diameter. The specimens are then placed in a hydraulic or screw press and squeezed to the breaking point. The number of pounds pressure per square inch required to break the stone is called the crushing strength. The range of crushing strength is commonly between 10,000 and 40,000 pounds.

and even rock of one kind may vary considerably. I have seen tests of diabase collected at one time from one quarry in which the crushing strength ranged from 18,500 to 32,000 pounds per cubic inch. With such variations a single test on the stone from any quarry would seem to have little significance, and the evidence all points to ample strength for construction purposes. Therefore this study did not include the making of tests.

The following table is compiled from records of tests made under the direction of H. S. Mattimore by the Testing Laboratory, Pennsylvania Department of Highways:

Tests on Pennsylvania stone for highways

Kind	Operator	Quarry location	County	Weight lbs. cu. ft.	Absorption lbs. per cu. ft.	Crushing strength lbs. per sq. in.
Limestone	American Limestone Co.	Bellefonte	Centre	167.9	0.17	28,528
"	Bessemer Limestone & Cement Booth & Flinn	Bakers Station	Beaver	169.1	0.50	19,733
"	Duncansville Lime & Stone Co.	Duncansville	Westmoreland	167.9	0.39	33,512
"	Fehr & O'Rourke	Shillington	Berks	171.1	0.17	19,740
"	Hoffman Bros. & Wilson	Paxtaug	Blair	169.0	0.23	18,245
"	"	"	Dauphin	171.1	0.27	17,129
"	"	"	"	175.3	0.19	25,579
"	Lemoyne Quarries Co.	Lemoyne	Cumberland	171.1	0.09	20,378
"	Lukens & Yerkes	Henderson	Montgomery	174.2	0.44	12,875
"	Mapleton Lime & Stone Co.	Mapleton	Huntingdon	169.0	0.13	33,222
"	"	"	"	169.0	0.05	21,543
"	Millard, Harry	Myerstown	Lebanon	168.4	0.33	22,052
"	New Castle Lime & Stone Co.	Hillsville	Lawrence	170.4	0.31	15,776
"	Northampton Quarry Co.	Northampton	Northampton	173.6	0.21	24,726
"	"	"	"	167.8	0.25	20,811
"	Penn Lime & Stone Co.	Rheems	Lancaster	174.2	0.26	25,514
"	"	"	"	171.7	0.19	28,049
"	Pine Creek Lime & Stone Co.	Jersey Shore	Lycoming	166.6	0.37	23,152
"	Stacy Wilton	Bittinger	Adams	171.7	0.45	18,636
"	Templeton Limestone Co.	Templeton	Armstrong	162.2	1.62	17,277
"	Warner, Charles Co.	Cedar Hollow	Chester	178.4	0.42	28,049
"	Whiterock Quarries	Pleasant Gap	Centre	167.2	0.15	24,053
Sandstone	Basalt Trap Rock Co.	Alexandria	Huntingdon	164.7	1.07	21,718
"	General Crushed Stone Co.	White Haven	Luzerne	169.1	0.17	23,718
"	Kibblehouse, Ralph T.	Perkionenville	Montgomery	172.3	0.36	33,077
"	Susquehanna Stone Co.	Dalmatia	Northumberland	167.9	0.24	35,903
"	Yang Construction Co.	Casparis	Somerset	166.0	0.50	19,806
Gneiss	Water Street Trap Rock Co.	Water Street	Huntingdon	164.7	0.74	19,052
"	Bethayres Quarry Co.	Bethayres	Montgomery	168.5	0.29	16,915
"	Devault Stone Co.	Devault	Chester	175.3	0.16	23,978
"	"	"	"	189.1	0.19	26,804
"	General Crushed Stone Co.	Glen Mills	Delaware	186.0	0.05	27,018
"	Keystone Trap Rock Co.	Cornog	Chester	181.6	0.45	45,074
Diabase	Dyer, John T. Company	Birdsboro	Berks	183.5	0.17	17,086
"	"	"	"	186.0	0.30	32,063
"	"	"	"	183.5	0.64	28,108
"	"	"	"	184.1	0.33	21,414
"	"	"	"	183.5	0.33	19,530
"	"	"	"	181.6	0.27	18,531
"	General Crushed Stone Co.	E. Rockhill	Bucks	189.1	0.28	27,832
"	"	"	"	187.2	0.11	21,573

¹ Siliceous limestone² Dolomitic marble³ Calcareous sandstone⁴ Granite gneiss⁵ Hornblende gneiss

GEOLOGY OF PENNSYLVANIA.

For an understanding of the distribution of the different building stones in the State a description of the geology will be helpful. It will show why all the granite and trap are in the southeast part of the State, why marble does not occur in the western part, and why limestone outcrops in a zigzag line up and down the central part of the State.

PHYSIOGRAPHY.

In the first place the State is sharply divisible into three physiographic provinces, the Piedmont Plateau, Vallemont region, and the Appalachian Plateaus.

The Piedmont Plateau extends from the Delaware River below Trenton to the line of ridges known as Lehigh, Neversink, and South mountains. This upland therefore extends up the Delaware to Durham Furnace and up the Susquehanna to Falmouth, and has a width of 35 to 75 miles. In Pennsylvania the Piedmont is a diversified upland of moderate elevation dissected by rather shallow, open valleys, which become narrower and more deeply incised on the eastern margin. The plateau descends from an elevation of 900 feet to an average of 400 feet near Philadelphia. Above it rise occasional hills which erosion has not reduced to the level of the plain. Long Hill near Boyertown and Gibraltar near Reading are examples of monadnocks rising 100 to 200 feet above the Piedmont. From such elevations the general flatness of the plateau surface is very apparent.

The Vallemont region, made up of a series of parallel valleys and mountains, is all that country between Lehigh, Neversink and South mountains on the east, and the Allegheny Front on the west. The Allegheny Front is the steep east-facing mountain slope that lies a few miles west of Schellsburg, just west of Altoona, Tyrone and Lock Haven, north of Williamsport, and thence pursues an irregular course eastward.

The Vallemont Region is divisible longitudinally lengthwise into two very distinct and unequal parts, the great limestone valley on the east and the broad belt of ridges and valleys. The great valley lies between South Mountain and its extension, and Kittatinny or Blue Mountain. It is a continuation of Shenandoah Valley in Virginia and known in Pennsylvania as Cumberland, Lebanon, and Lehigh valleys. Its western boundary, Kittatinny Mountain, which follows a direct course from Delaware Water Gap past Slatington, Hamburg and Harrisburg nearly to the Maryland line, is the easternmost of a number of parallel ridges. The distinctive features of this second part of the Vallemont region are long, parallel, sharp-crested ridges and narrow intervening valleys, all crossing the State from northeast to southwest. The valleys though narrow are generally much wider than the intervening ridges. The major ridges are characterized by long, even, almost uninterrupted crest lines, and by uniform and but slightly dissected slopes. Marked parallelism between the ridges is a striking feature of a map of this region. Minor ridges subdivide some of the valleys.

All of the ridges are developed on the edges of hard upturned beds in antilinal folds, or the remnant of a hard bed at the bottom of a syncline. The rocks in this part of the State have been compressed into great folds of which the mountains are the eroded stubs. All the

larger valleys are determined in position and direction by the arrangement of the more easily eroded rocks, and have been developed subsequent to the folding.

The courses of the smaller streams are generally parallel with the structure. The larger streams, however, do not adhere strictly to this general rule but, after flowing parallel with a larger ridge for some distance, turn abruptly and cut through the ridge in a narrow gorge, after which they may again assume the parallel course.

The Appalachian Plateaus extend from the Allegheny Front westward to the Mississippi lowlands and, hence, include all the western and northern part of the State. The plateau is now so dissected as to be recognizable only by a broad view from a position at or just above its general level. That the deeply dissected region once was a plain is suggested by the general accordanee in elevation of the hill and ridge summits. The whole western part of the State which is included in the plateau region is now a monotonously hilly country. The old plain is broken up into a mass of irregular ridges without systematic arrangement, and the valleys commonly are narrow and several hundred feet lower than the crests of the ridges.

STRATIGRAPHY.

The Piedmont Plateau is underlain by rocks of diverse origin. They include crystalline and greatly metamorphosed crystalline and sedimentary rocks. The oldest formations are of sedimentary origin, but they have been subjected to pressure and metamorphism, which have produced granitic texture and an obscurely banded structure. This is the gneiss that forms part of the composite floor of the Piedmont. Later formations, chiefly of sedimentary origin, were accumulated beneath the sea which covered this part of the globe in pre-Paleozoic time, were consolidated by pressure and cementing material, and subsequently were uplifted and folded. This folding developed the sediments into hard, crystalline, finely banded quartz-feldspar gneiss, and a mica gneiss.

The pre-Cambrian crustal movements which changed the sediments to gneiss were accompanied by the intrusion of igneous rock, which consolidated as granite, gabbro, pyroxemite, and peridotite.

At the beginning of Paleozoic time a narrow straight lying between Appalachia and the land on the west received sediments which formed the sedimentary rocks of the Appalachian Province. The deposition on the gneiss was successively sands, sands and clays, limes, and lastly, clays. The lower part is chiefly of mechanical origin and up to 5,000 feet thick, while the upper part is organic or chemical, and in Pennsylvania up to 10,000 feet thick. These rocks, deposited in Cambrian and Ordovician time, underlie a considerable portion, but not all, of the Piedmont. The formation of limestone, due to chemical precipitation or to microscopic organisms, continued from the Cambrian over into Middle Ordovician time. Folding and faulting changed the character of these rocks, and they are now the Chickies quartzite, Shenandoah limestone, and Octoraro mica-schist.

The crystallized sediments and igneous intrusions in the Piedmont Plateau where exposed make detached belts trending northeast and southwest.

After long erosion of these rocks a shallow inland estuary extending across southeast Pennsylvania in Triassic time received fine sands

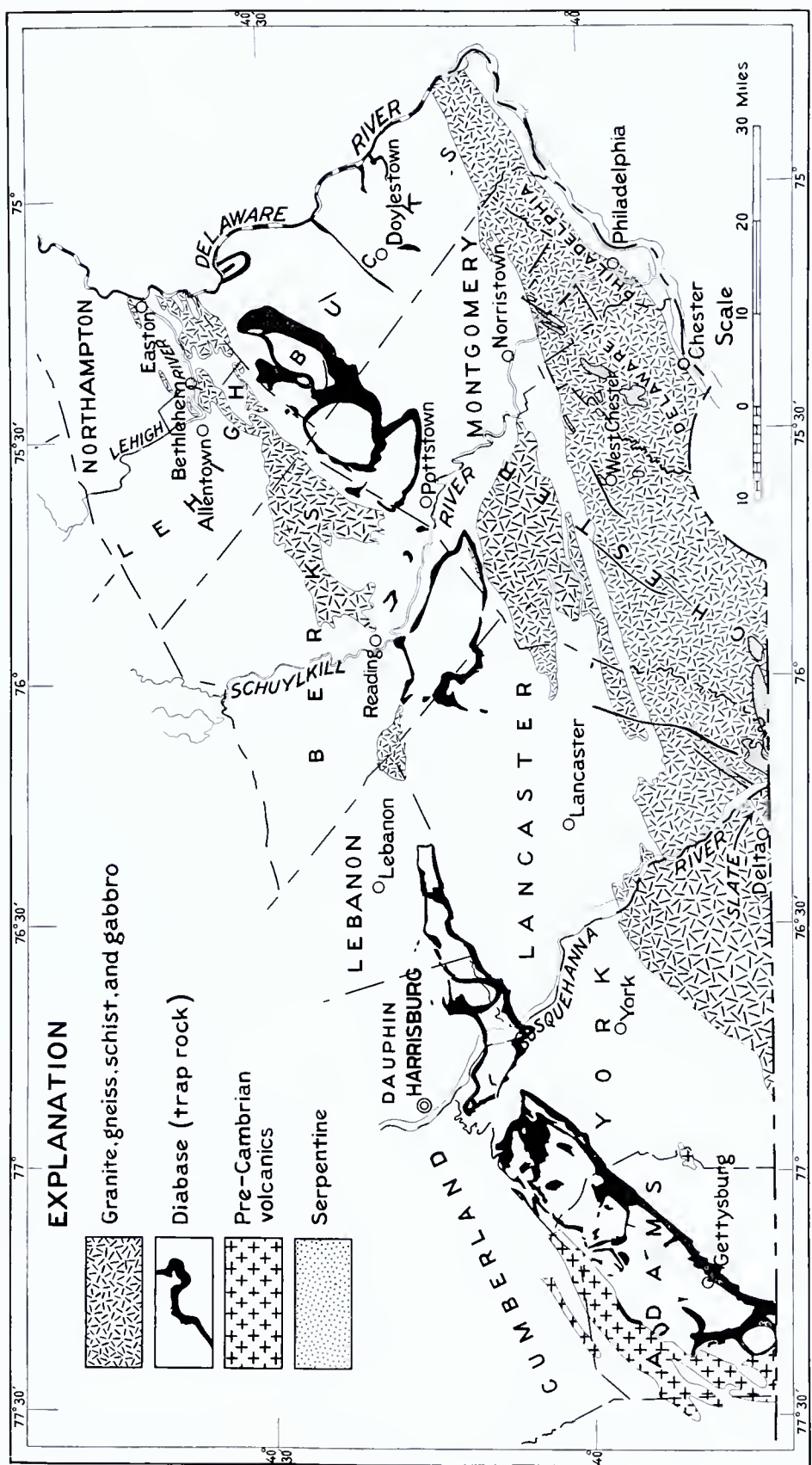


Fig. 11. Map of southeastern Pennsylvania showing areas of granite, diabase, serpentine, and volcanic rocks.

and mud from land on the east. This estuary seems to have sunk along its western margin until several thousand feet of red sediments accumulated. At the same time molten rock was intruded between the beds of sediment or traversed fissures in them. These sediments were consolidated and uplifted without being metamorphosed, and in Pennsylvania are known as the Stockton and Lockatong sandstones and Brunswick shale, or as the New Oxford formation and Gettysburg shale in Adams County. The contemporary igneous intrusives are diabase and basalt, or trap, and form eminences, as Haycock Mountain, Rock Hill, Gibraltar Hill, Roundtop, and many other lesser elevations.

In the Vallemont region the Silurian and Devonian rocks are prominently exposed. Farther west they are deeply buried under the Appalachian Plateaus. The rocks consist of many thousands of feet of sandstone, sandy shale, and shale, including the Juniata and Tuscarora sandstones at the base of the Silurian and the Oriskany sandstone near the base of the Devonian. Changes in the sea brought about the deposition of limestone, especially at the beginning of the Devonian when the Helderberg was laid down.

The sediments seem to be mostly those of shallow water, but the great thickness and recurrence of similar conditions suggest a fluctuating but continual, deepening sea. Following the close of the Devonian with the deposition of Catskill red beds came the Carboniferous era, which was ushered in with a change from mud to sand, resulting in the laying down of the Pocono sandstone. As the deposition of this coarse sandy material was drawing to a close, a large quantity of carbonate of lime was deposited with the sand, making what is known in Pennsylvania as the Loyalhanna or "siliceous" limestone.

Another change in the relation of the lands to the sea brought a return of conditions similar to those in the Devonian, and the limestone was covered with a great thickness of red mud, the Mauch Chunk series, which decreases from 2,000 feet thick at Mauch Chunk to 180 feet at Altoona. Then after partial and irregular erosion the Pottsville conglomerate was laid down. Succeeding it was a long series of crustal fluctuations resulting in the Coal Measures. Times of submergence and deposition were followed by partial emergence, the development of luxuriant plant life, and the deposition of the vegetable matter which subsequently formed the coal beds. The geologic history recorded in the Carboniferous sediments tells of a series of rapidly alternating conditions frequently repeating themselves. That marine conditions prevailed at times is evidenced by the salt water fossils in the Brush Creek and Ames limestones. Sedimentation seems to have continued until the Appalachian Gulf was completely filled.

APPALACHIAN REVOLUTION.

From the beginning of deposition in the interior sea, subsidence had been going on intermittently and sediments had been deposited until thousands of feet of strata had accumulated. From the close of the Carboniferous period until the present time the reverse movement—elevation—has prevailed in this region.

The change from subsidence to elevation, known as the Appalachian Revolution, was produced by compressive stresses, which resulted in warping the rocks into great folds. The movement was most severe along the eastern side of the Vallemont region, where the rocks were

not only closely folded but in many cases metamorphosed. In the Allegheny Plateaus the disturbance was less severe and the rocks were warped into broad, comparatively low folds. In a measure the bituminous coal basin seems to have acted as a bulwark against which the stress coming from the east crushed the rocks of the Piedmont Plateau and Vallemont region. The folding decreases rather steadily westward.

As the new land surface rose gradually from the sea, owing to the compressive forces, erosion commenced and has continued to this day. Before the close of the Cretaceous period the Appalachian Province was worn down to a nearly horizontal plain. Its unequal elevation and subsequent erosion have produced the present topography.

From the discussion above it will be understood that all the granite, gneiss, schist, and other igneous and highly metamorphosed crystalline and sedimentary rocks are in the southeast corner of the State, south of a line through Bethlehem and Harrisburg. All of the marble is south of this line because only there was metamorphism severe enough to change limestone into marble. All the trap rock in the State except a few narrow dikes, is here because it was intruded mainly in Triassic sediments, all of which lie south of this line.

Sandstones and limestones are abundant, and widely distributed and exposed in the Vallemont region, but in the Allegheny Plateau or western part of the State, the only building stone is sandstone of Carboniferous age, except in limited areas where the Vanport, Benwood, and Loyallhanna limestones are well developed.

Geologic relation of formations yielding building stone.

System, years	Kind of stone	Geologic name	Remarks
Triassic 40,000,000	Dialase (intrusive)		confined to southeast corner of State. Large quarries for crushed stone near Birdsboro and Quakertown. Monument stock at Coopersburg and St. Peters.
	Sandstone		
Permian 35,000,000	Sandstone	Waynesburg	In Greene and Washington counties
	Limestone	Benwood	
Pennsylvanian 40,000,000	Sandstone	Pittsburgh	In Coal Measures in western part of State. Used for local construction.
		Cornellsville	
		Morgantown	
		Saltsburg	
		Mahoning	
	Limestone	Butler	Beaver, Butler and Lawrence counties
		Freeport	
		Kittanning	
	Sandstone	Vanport	Principally along Allegheny River
	Sandstone	Clarion	
Mississippian 40,000,000	Sandstone	Pottsville	Widely distributed around margin of anthracite and bituminous coal fields. In western counties divided into Homewood and Connoquenessing sandstones, with Sharon or Olean conglomerate at base.
		Mauch Chunk	
		Loyalhanna	
	Limestone	Pocono	Quarried in Carbon, Luzerne and adjacent counties.
	Sandstone	Catskill	In Fayette, Westmoreland, Somerset and Cambria counties
Devonian 50,000,000	Sandstone and limestone	Chemung	Widely distributed in central and northern part of State.
		Portage	
		Genesee	
		Hamilton	
	Sandstone Limestone	Marellus	Abundant in central or Vallemont region
		Onondaga	
		Oriskany	
		Helderberg	

Silurian 40,000,000	Limestone Sandstone	Tonoloway	Principally in central or Vallemont region
	Sandstone	Tuscarora Juniata Oswego	Called Medina and Oneida in early reports. Occurs in Kittatinny or Blue Mountain and in many other mountains of Vallemont region
Ordovician 60,000,000	Slate and sandstone	Martinsburg	Slate in Northampton, Lehigh and Berks counties
	Limestone	Trenton Black River Lowville	In valleys of Vallemont region
Canadian 50,000,000	Limestone and marble	Shenandoah Beekmantown, Bellefonte, Nittany, Conococheague, etc.	In valleys of Vallemont region and Chester Valley
Cambrian 90,000,000	Limestone Schist	Shenandoah Ellbrook, Tomstown, etc.	In Cumberland and Chester valleys and Bedford to Bellefonte
	Quartzite and schist	Harpers Chickies	In South Mountain and ridges of southeastern part of State
Algonkian	Slate	Peach Bottom	Near Delta and Peach Bottom, York and Lancaster counties
	Schist and quartzite	Peters Creek	In southern Chester and Lancaster counties
	Gneiss	Wissahickon	Principally in Philadelphia, Delaware, and Chester counties
	Marble	Cockeysville	In southern Chester County
	Quartzite	Setters	In Chester County
Archean	Granite, gabbro, gneiss, serpentine		Chester, Delaware and Philadelphia counties
	Marble	Franklin	Chester County
	Gneiss	Baltimore	Delaware and Chester counties
	Granite		South Mountain, Berks County
	Rhyolite, etc.		South Mountain, Adams County

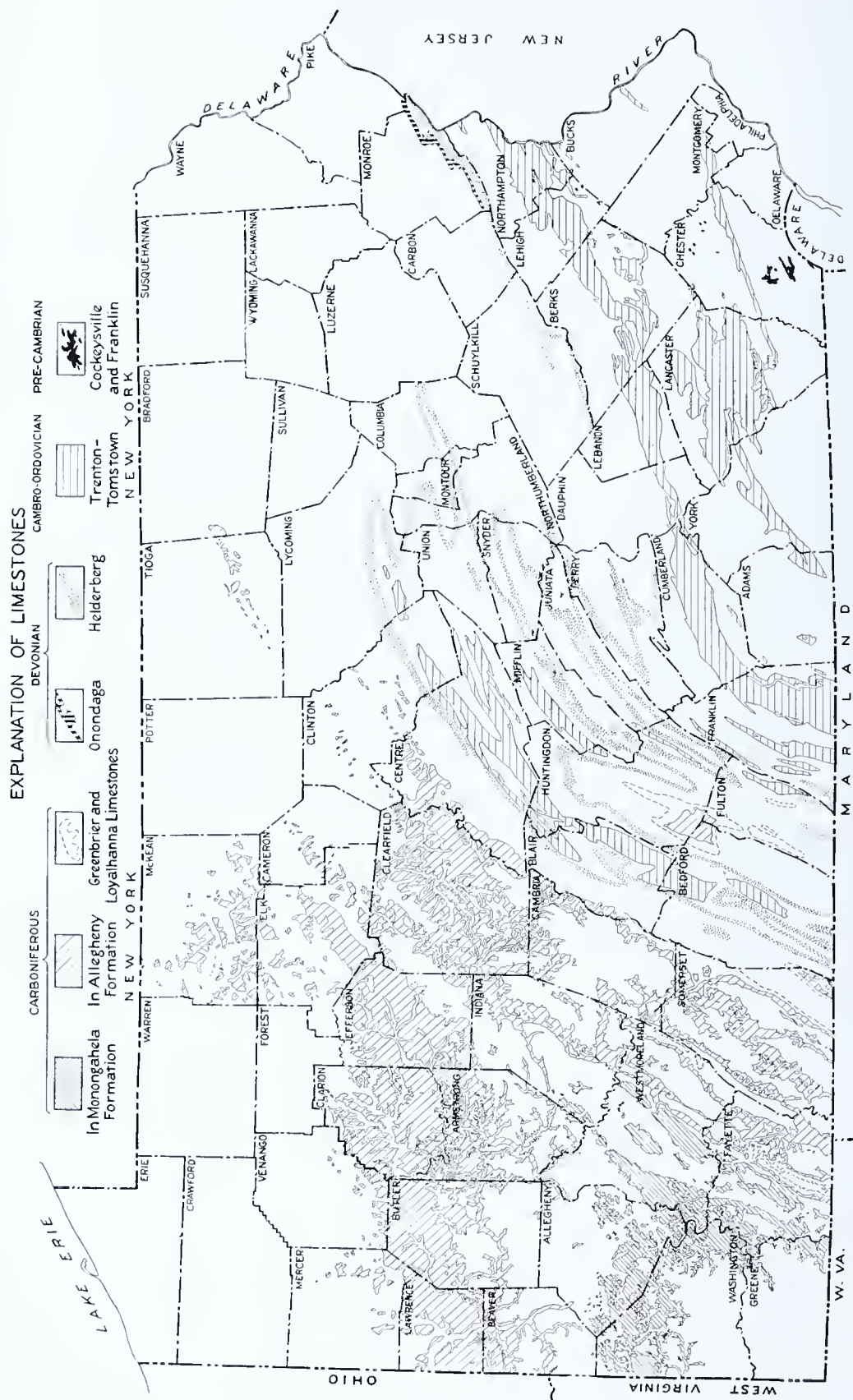


Fig. 12. State map showing distribution of limestone.

DISTRIBUTION OF BUILDING STONE.

On the accompanying map showing the distribution of building stone quarries, it is noticeable that 12 counties contain no quarry symbols. This lack of symbols does not mean a lack of building stone, but in most cases an abundance of float rock which furnishes all the stone needed without opening a quarry. In Cameron, Elk and Forest counties the population is scanty and timber is abundant, so there is little call for stone buildings. In the nine counties from Schuylkill to Huntingdon, there are many stone buildings, including old mills and farm houses, and stone quarries may have been opened here, but they must have been few and I know of none active now. Stone suitable for building is so abundant on the mountains near Pottsville, Lewistown, Huntingdon and other places in these counties that select material is obtained by breaking surface boulders. Building stone for rough construction can be obtained in any county in the State. The map shows the distribution of the different kinds of stone, and makes clear how closely the igneous rocks are confined to the southeast corner of the State, and how very widely sandstone is distributed. When it comes to dressed stone, however, the places where it could be produced are numerous, but the places where stone is actually dressed to dimension blocks at the quarry are very few. For the most part native building stone is dressed on the job, if dressed at all.

Bridge and culvert masonry, particularly for railroads, is usually of massive blocks, much larger than used in ordinary house construction. Blocks 12 to 18 inches thick, 2 feet wide and of random length are common in bridges. Such blocks can be obtained only in quarries where the bedding planes, or rift and joints are far apart. Common sources of such large blocks are the quarries in the northern part of Beaver County, in Clearfield County near Curwensville, in the Loyalhanna limestone on Chestnut Ridge. Massive blocks for bridges and canal locks have been made also in the eastern part of the State from the diabase or trap, from gneiss and granite, and from an occasional bluestone quarry.

Monument stock or grave stones were made in Colonial days from brownstone and later from the marble in Chester Valley. These, however, are not the best of material, inscriptions on some of them being nearly obliterated in less than 100 years of exposure to the weather. The only finished monument stock produced in the State at present is the diabase, trap, or "black granite" that is quarried, dressed and polished at French Creek, Chester County, and Coopersburg, Lehigh County.

Curbing is produced from heavy stock in the bluestone quarries of northeastern Pennsylvania, from the red sandstones near White Haven, Carbon County, from granitic rocks in the Philadelphia region, and from massive sandstone in Clearfield and Beaver counties. Formerly curbing was made from brownstone in Danphin County, and elsewhere from local sandstone and limestone.

Flagging is raised almost exclusively on the bluestone region of northeastern Pennsylvania, a region which extends from Milford and Port Jervis on the Delaware as far west as Jersey Mills and Tioga. Flags have been raised elsewhere but only in small quantity for local use. Paving blocks have been made from granite and gneiss in the

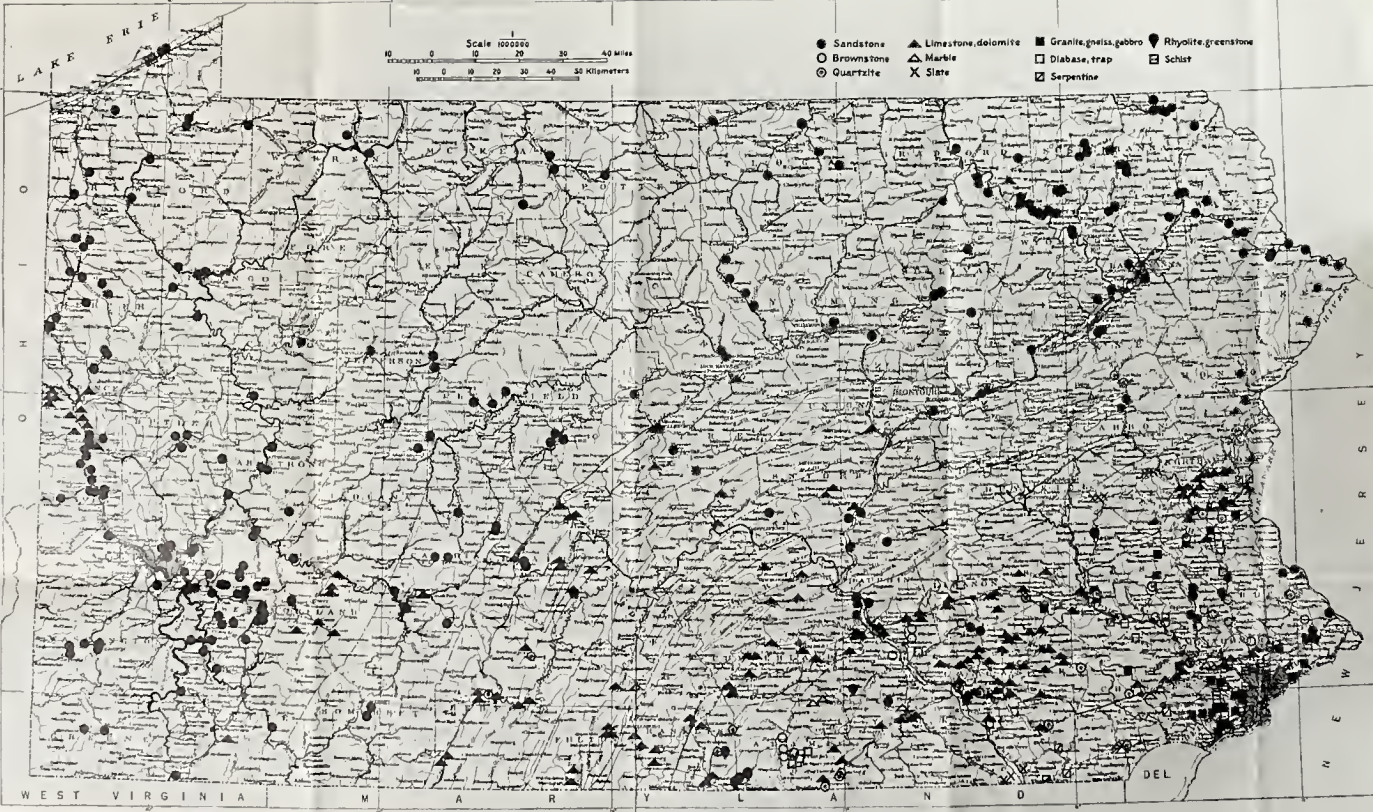
Philadelphia region, from trap near Quakertown and on French Creek, from sandstone near White Haven, and from siliceous limestone in Westmoreland County.

At present the building stone most widely used in Pennsylvania is Indiana limestone. This stone, which is easily recognized by the abundance of fragmental fossil shells and oolites, and by its gray to buff color, is produced on such a gigantic scale that it can be marketed in this State in direct competition with local stones. Many banks, steel framed office buildings, and monumental bridges in Pennsylvania are faced with Indiana limestone.

Another building stone increasingly used in this State is white granite from Mount Airy, North Carolina. This beautiful stone is quarried on such a large scale and furnished in blocks of such regular dimensions that it competes successfully in Delaware County with the local granite gneiss.

The following description of the building stone resources of Pennsylvania, arranged alphabetically by counties will show that a considerable variety of stone is available and is or has been quarried in all parts of the State.

The photographs used for illustrating this report were made by the author, unless otherwise credited. It will be observed that more of them show use of the stone than source. This is intentional because builders are more interested in how a stone looks in a building than they are in how it lies in a quarry.



ADAMS COUNTY.

This wholly agricultural county on the Maryland boundary named for President John Adams, will be identified in the minds of many when it is recalled that the county seat in Gettysburg where the decisive battle of the Civil War was fought in 1863. Geology had much to do with this bloody contest, for Round Top owes its eminence to the superior hardness of the diabase or trap rock, of which it is composed. This rock also characteristically litters the surface with large blocks which, on this battlefield, furnished shelter for sharpshooters. Devils Den and the jumble of lesser blocks of diabase around the base of Big and Little Round Top were impregnable strongholds, and the stone walls made by the farmers in clearing their fields likewise were a screen for the fighters and a protection from bullets. This diabase, which extends in a broad dike across the county, has been a source of building stone in years past, principally for farm houses and barns on or near the outcrop. It has been used rarely for town residences because of its dark color.

At least half of Adams County is underlain by soft, mostly red, sandstone and shale of Triassic age. Into these sediments are intruded considerable areas of a fine-grained, dark colored igneous rock known as diabase, trap rock or iron stone. The Pigeon Hills north of Hanover contain some volcanic rocks and the hills in the southeast corner of the county are schist. An area of Ordovician limestone extends from the Pigeon Hills to Littlestown and there is a small area north of Fairfield. All the western part of the county and the northern part adjacent to Cumberland County is composed mostly of quartzite, and pre-Cambrian volcanics. The volcanics have been used in South Mountain for building stone, as at Mont Alto Sanitarium and in railroad bridges. (See Fig. 13)



Fig. 13. Rhyolite porphyry from South Mountains in abandoned railroad bridge near Virginia Mills, Adams County.

The building stone resources of Adams County have been adequately described by Stose¹, from whom the following pages are quoted:

"Several kinds of rock in the area are or have been used for building stone. Some have been used chiefly as dressed stone in the superstructure, others as rubble in foundations, walls, bridge piers, and stone arches, whereas some are specially suited for steps, sills, lintels, culvert stones, curb stones, and flagstones. Inasmuch as one kind of rock may be quarried for more than one of these purposes and some quarries have turned out several of these products, all such rocks will be described under the heading 'building stone.' Crushed stone, however, will be described under a separate heading. In the last 20 years concrete has increasingly replaced stone for building purposes. On this account, many of the quarries that formerly produced building stone and are described under this heading in this report are now producing only crushed stone or have ceased to operate."

Diabase, Gettysburg "granite."

"Diabase, a coarse granular crystalline rock intrusive in the Triassic sedimentary rocks, has been quarried in the vicinity of Gettysburg for building stone. It is locally known in the trade as 'Gettysburg granite.' Because of its generally dark color it is somewhat somber for building stone but makes a very substantial structure. It is extensively used in Gettysburg as dressed stone in retaining walls, culverts, gutter and curb stones, steps, and monuments, and as rubble in foundations, and several buildings have been constructed of it.

"Diabase is a rock resembling granite in that it is a compact, granular crystalline rock, but is darker than granite because it contains less of the light-colored mineral quartz and more of the dark-colored ferromagnesian minerals—augite, magnetite, and sometimes olivine. The feldspars also are largely plagioclase instead of the lighter-colored orthoclase. Because of the intricate intergrowth of the crystals of these component minerals the rock is tougher than most granites and harder to dress and work, and a well defined grain and rift are generally lacking or imperfect, but in the vicinity of Gettysburg these structures are fairly well developed so that dimension blocks having smooth surface and of uniform size can generally be quarried. Diabase resists weathering about as well as granite, and is not as badly affected by fire. It is dense, so that it can be given a high polish and can be used for decorative purposes. Diabase has not been quarried for building stone on a large scale in the county. The product of the 10 or more quarries to be described was largely used in Gettysburg and vicinity.

"The chief body of diabase in Adams County is the large sheet or sill which outcrops in a belt a mile or two wide that crosses the county diagonally northeastward just southeast of Gettysburg. In most of the quarries in this belt the rock is noticeably broken by widely spaced nearly vertical joints having two or more directions. In addition it has a pronounced horizontal rift, which tends to break the rock into horizontal sheets, and a vertical grain in two directions nearly at right angles to each other. The method used in working the best of the quarries is to expose a large face of the rock along a

¹ Stose, Geo. W., Mineral resources of Adams County, Pennsylvania: Pa. Top. and Geol. Survey, Bull. C-1, pt. II, pp 10-17, 1925.

vertical northeast-southwest joint plane, which is also the direction of easiest vertical splitting or principal grain. A large block, about 10 feet thick, to insure vertical splitting, is then split along the principal grain for a length of 20 feet or more. A block 10 or more feet high is then loosened by wedges along the horizontal rift, and this is finally split into smaller lengths along the vertical southeast-northwest grain. In breaking up a mass into smaller blocks, it is split in the middle to insure a straight even break along the grain. By this means regular blocks 13 inches wide, 7 inches thick, and 13 feet long are broken out for use as steps. These require only a little tooling to give the surfaces proper smoothness. Blocks of other dimensions suitable for culverts, curbstones, walks, etc., can similarly be obtained.

"The quarries of high-grade building stone were active several years ago, but are now idle. All are located along the west slope of the diabase hill which extends from Rocky Grove school 2 miles east of Gettysburg to the Baltimore pike, $2\frac{1}{2}$ miles southeast of Gettysburg. They lie almost in a straight line which trends southwest, parallel to the sides of the diabase mass and about at its middle. The high-grade rock is apparently limited to the medial zone in which the rock breaks more regularly, due to the fact that the diabase sill when it was intruded into the Triassic sediments, cooled simultaneously from both the top and bottom. The strains developed in the middle of the cooling mass, which cooled slowly, were equal in all directions and the rock solidified as a homogeneous even-grained mass, which would split in one direction as readily as another. The principal vertical grain in a northeast-southwest direction parallel to the sides of the sill, which the rock now possesses, was probably produced by later compression of the solidified rock normal to this direction. The fact that the quarries are about one-half mile apart along this medial zone is probably accidental, determined largely by accessibility, and the intervening rock along this zone is believed to be equally good. The diabase quarries, will next be described beginning at the north.

"One of the largest quarries is at Granite Hill, 4 miles northeast of Gettysburg. It was opened by the Gettysburg Granite Company which built capacious buildings at the railroad depot for storage, work shop, offices, and commissary, and evidently had prepared to put large quantities of Gettysburg 'granite' on the eastern market. A railroad spur winds its way spirally around the hill from the main line to the quarry 60 feet above, on the south side of the hill. Two smaller openings are lower down on the north side of the hill and a large old quarry hole in the lowland north of the railroad track is full of water. The main quarry face is about 40 feet high and 50 to 60 feet long. Huge blocks which had been broken loose are somewhat irregular in shape, suggesting that the grain is not as even and regular as is desirable for the most economic working of the stone for building purposes. The horizontal sheets are 10 to 15 feet thick. The rock is fine even grain and dark gray. This quarry is said to have furnished stone for a bridge across the Potomac River at Harpers Ferry. Prior to 1913 the quarry had been idle for several years, and the office buildings, railroad, and equipment, though still intact, showed signs of depreciation from disuse. From 1913 to 1918 it was operated by B. F. Pope for crushed stone, and in 1919 by M. Bennett & Sons of Indiana, Pa. In 1924 P. W. Stallsmith of Gettysburg was quarrying rock here for a residence close by on the Lin-

coln Highway. This newer quarry face is 200 feet long and about 10 feet high.

"L. O. Beitler's quarry at Roeky Grove school, 2 miles east of Gettysburg, was one of the best building-stone quarries in the area. It had a quarry face 20 feet wide and 10 feet high. The rift and grain are well developed and the rock splits with an even fracture. The stone is a fine-grained, evenly speckled gray rock of pleasing appearance, and was used for building, for steps, and for monuments. The Beitler quarry has apparently been idle since 1917.

"One mile southwest, just south of the Hanover road, several small quarries from which culvert stones and steps were obtained lie along the west side of the diabase ridge. Some of the surfaces of the split stone from these quarries are stained with rust from surficial waters that follow the joints and horizontal sheeting, which gives the product a distinctive quality as a building stone. Half a mile farther southwest, on the west side of Wolf Hill, is the Zeigler quarry, operated up to 1915 by C. W. Zeigler & Company. Some of the product of this quarry was dressed and polished in Gettysburg for cemetery monuments.

"J. W. Flaharty's quarry, $1\frac{1}{2}$ miles southeast of Gettysburg and southwest of Wolf Hill, had one of the largest quarry faces in the region, 15 feet high and 15 to 20 feet long. Blocks 6 feet by 4 feet by about 8 inches thick were mostly quarried for use in massive walls of large buildings. The rock is dark gray and some of it is very coarse-grained. The quarry has apparently not been operated since 1908.

"Near the Baltimore pike $1\frac{3}{4}$ miles south of Gettysburg is the quarry of the McAllister Company. The rock is of the usual character, gray and compact, and splits readily along the grain so that building blocks 6 inches to a foot thick, 1 to 2 feet wide, and of various lengths are commonly quarried. This quarry was deeper than any of the others, and like them has been idle many years.

"Bushman's quarry, on the south side of Culps Hill, 1 mile southeast of Gettysburg, was originally worked for building stone and later furnished crushed stone for the government roads of the Gettysburg reservation. B. F. Lightner's quarry, on the northeast side of Powers Hill, 2 miles south of Gettysburg, was formerly an active building stone quarry and furnished the large dressed stones used in the wall around the National Cemetery in the Gettysburg Military Park. Another nearby quarry operated by Nathaniel Lightner was active until about 1905.

"In the United States quarry on the southwest side of Powers Hill the horizontal sheeting is more highly developed, causing the rock to break into thinner layers than in most places, so that the rock splits into horizontal slabs of suitable thickness for gutter and curb stones, for which it was largely used. Probably the thin sheeting is surficial and the layers will be thicker with depth. This quarry has not been in operation in several years."

The Miller quarry half a mile north of Round Top station on the electric railroad has been operated in recent years by Emory Rosensteel, and produced dressed stone for steps, lintels, culverts, and building stone. As he works alone the production of stone is small.

Triassic sandstone.

“Some of the thicker beds of Triassic sandstone are locally quarried for building stone. Many of the old historic houses in and around Gettysburg and old hostelryes and homes along the Pittsburgh-Baltimore turnpike and other historic highways in the county were built of this red or brown rock. Some of the old arch bridges are also built of it. (See Fig. 14).



Fig. 14. Bridge of Triassic red and green sandstone over Marsh Run, southwest of Gettysburg, Adams County. The Confederates retreated over this bridge after the battle of Gettysburg in July 1863. Photo by Pa. Department of Highways.

“The color of the rock is a rich dark reddish brown, pleasing as a building stone and especially attractive for lintels, door steps, and trimmings to brick and stone houses. Much of the rock, however, scales badly after years of exposure, especially on the exposed bedding surfaces. Moisture, which enters certain bedding planes, probably more porous layers, freezes in cold weather and expands, causing thin sheets to scale from the bedding surface. Some layers crumble to grains under the same weathering process. This weathering seems to affect the sawed stones more noticeably than the rough dressed, and buildings made of the smoothly finished dressed rock in time become rough surfaced and scarred by scaling, so that the stone has become less popular for building purposes in recent years.

“The red or brown building stone occurs chiefly in the western part of the Triassic sandstone area, west of the Gettysburg diabase sill. Large firm blocks for dam construction were quarried 1 mile west of Gettysburg, and foundation stone for dwellings is obtained at several small quarries near Gettysburg and New Oxford, but quarrying on a large scale has not been attempted in the county as layers of proper thickness, sufficient firmness, and good color for building stone do not occur in large quantity. Many of the beds of lighter colored

Triassic sandstone, which occurs chiefly east of the Gettysburg diabase sill, are somewhat firmer than the brown sandstone and have been locally used in dwellings, barns, and foundations. Hard red and green argillite, or hardened, baked shale, has been quarried for foundation stone 2 miles northwest of Gettysburg. It commonly occurs as a zone of variable thickness along the contact of Triassic shales and large intrusive masses of diabase. It generally breaks into such small masses in quarrying that it is better suited for crushed stone.

"One mile northwest of York Spring, hard beds of Triassic conglomerate are quarried on the Dietrich property for foundation stones and walls in York Springs. The rock contains rounded pebbles of white quartz and quartzite up to 3 inches in size. The rock weathers porous and pitted, and therefore has a rough appearance."

Cambrian Quartzite.

"Cambrian quartzite occurs chiefly in South Mountain, in the western part of the county, but it also occurs in the Pigeon Hills at its eastern edge. Most of the quartzite is so massive and thick-bedded that it yields irregular-shaped masses when quarried, but the beds adjacent to the limestone of the lowland occur in thin, even layers, suitable for building stone. These thinner beds have been quarried north of Caledonia Park, just west of the Adams County line, and this quartzite has been used to build houses in the villages along the Chambersburg-Gettysburg pike and on adjacent farms. It is slightly stained by iron oxide which gives it a pleasing yellow or brown color. Irregular quartzite blocks obtained by quarrying the more massive beds are used in walls, fences, and in dwellings along the pike in the western part of the county. This rock is popular in the construction of summer homes recently built in South Mountain. It was used in the construction of the Caledonia iron furnaces and other furnaces in the South Mountain and is extensively adapted because of its refractory or heat-resisting character."

Schistose rocks of South Mountain.

"The schistose rocks of South Mountain have been quarried on a small scale for rough flagstones, which are used for culverts, rural walks, and similar purposes. The lower schistose Cambrian quartzite in most places breaks readily along shear planes into great slabs, and rough flagstones of large size are obtainable from this formation on the east slope of Piney Mountain, the west side of Mountain Creek valley, and elsewhere in the area of Cambrian quartzite in South Mountain. On the east side of Buchanan Valley, a narrow band of this rock has been locally quarried for flagstones.

"Some of the hard pre-Cambrian rhyolite porphyry has a marked schistose structure and on weathering breaks into large irregular slabs having rough sheared surfaces. This rock is harder and more enduring as flagstones than the schistose quartzite, but it is more difficult to work into usable stone. This porphyry composes most of the high ridges of the central part of the pre-Cambrian area, chiefly Big Hill, Bear Mountain, Snaggy Ridge, and Mount Newman. Slabs hauled from the mountains and roughly dressed are extensively used for

walks and other purposes on the farms and in the smaller towns and villages. It is also quarried at Bridgeport, $1\frac{1}{4}$ miles northwest of Arendtsville. The quarried rock is so irregular in size and thickness that it is difficult to dress properly so that it will lie smoothly and evenly, and consequently it does not make so satisfactory a sidewalk as concrete, and the latter is gradually supplanting it, even in the smaller towns."

The metamorphosed volcanic rocks in South Mountain, metarhyolite and metabasalt, commonly porphyritic and of various colors, have been used but little for building stone because, except for summer homes along two main highways, this region is very thinly settled, and other stone is plentiful outside the mountains. Red and green porphyry of local origin was used in stone bridges for a railroad that was never completed. One of these bridges is in the narrows of Middle Creek above Virginia Mills, and another crosses Toms Creek a mile above Iron Springs. Stones in the arches of these bridges are well dressed and the rest are roughly squared blocks of random size and shape, and smaller than common in railroad bridges. In the 50 years since they were built trees have grown on them and some of the blocks have been displaced, but the possibilities of this stone are demonstrated.

Limestone has been quarried extensively near Bittinger for flux, for chemical, building, and agriculture lime, and for crushed stone but has not been used much for building purposes, perhaps because the limestone does not outcrop conspicuously. There are few natural rock outcrops in the lowland underlain by the limestone. Furthermore, in some of the quarries the limestone is so closely fractured that it is best suited for crushed stone, and in others, though massive white marble and light gray dolomite are quarried, there is no demand for it as building stone.

Limestone has been quarried at several places near York Springs but all quarries there have been idle many years. Massive light-gray magnesian limestone, white, gray, and pink crystalline marble, some brecciated, and some with fine black seams occur here. A brecciated white marble cemented with green limestone makes a handsome ornamental stone when polished, and might be a pleasing building stone if it can be obtained in sizable blocks.

Stose's report quoted above contains also a description and several illustrations of porphyries and breccias from South Mountain that have interesting possibilities as ornamental stone, for use as desk furniture, arts-and-crafts jewelry, mantels, table tops, etc.

ALLEGHENY COUNTY.

Allegheny County may be identified as the one in which Pittsburgh lies, and where the Allegheny and Monongahela Rivers join to form the Ohio. It is the second most populous county in the State, with 1.635 people per square mile in 1920. Only Coal Measure rocks are exposed in this county, the lowest rocks in the section being the Kittanning sandstone and the highest up in the Dunkard group. This means that the only stone in the county possibly suitable for building purposes is limestone and sandstone. Several limestone beds

crop out in the county and have been used in a small way for road metal and lime, but as they are generally less than 3 feet thick and not good quality, limestone has been used rarely, if at all, for building stone.

Sandstone beds suitable for rough masonry, and some for better work, are widely scattered over the county, many of the outcrops being on hard roads which make transportation to market easy.

The following paragraphs on the occurrence and use of sandstone in this area are from the Atlas of Pennsylvania—Pittsburgh Quadrangle, by M. E. Johnson, 1929.

“Waynesburg sandstone.

This sandstone is thick only in the southeast corner of the quadrangle. In Sewickley and Elizabeth townships it caps a number of the hills and there are many places where it could be quarried cheaply. As it is a rather soft sandstone, and thin-bedded, its use is not recommended except as a cheap grade of road metal.

Sewickley sandstone.

As a rule, only the lower beds of the Sewickley sandstone are massive and there are few places in this quadrangle where a quarry could be located with the certainty of having 25 feet of hard sandstone. Individual beds are seldom as much as 2 feet thick and are not persistent. Taken as whole, the Sewickley sandstone is fit only for rough construction work and road metal.

Pittsburgh sandstone.

Near Fairhaven the Pittsburgh sandstone is hard, massive-bedded, and thick. Several quarries are located in the vicinity and the stone can be seen near by in retaining walls and foundations. One home was also seen that was built entirely of this sandstone. None of the quarries are being operated at the present time and it is doubtful if they will be re-opened until a demand arises for a more permanent and durable type of home than is now being constructed in that district.

The Pittsburgh sandstone has also been quarried in the southwest corner of North Versailles Township, north of Pitcairn, and at one or two other localities.

Connellsville sandstone.

Ordinarily the Connellsville sandstone is so much cross-bedded as to make it unfit for any purpose except the roughest kind of stone work and for road metal. In some places, however, the beds are very massive, and hence suitable for heavy construction work. Such beds may be conveniently seen at the quarry of the Iron City Brick and Stone Company, near Allegheny Cemetery, and in an abandoned quarry a third of a mile north of the Brady Street bridge, Pittsburgh. The sandstone in these two quarries is medium-grained, gray on fresh fracture or buff when weathered, hard, and massive. The texture is even-grained and it is believed that blocks of the sandstone could be easily cut and shaped on modern stone-working machines.

Where the Connellsville sandstone is in thin beds separated by shale, flags have been frequently used for construction work and in artistic walks.

The Connellsville sandstone seems to have its maximum development along a northeast-southwest line through the center of the quadrangle, but it is thick enough to be quarried in the greater part of all the areas in which it outcrops.

Morgantown sandstone.

This is by far the most valuable of the sandstones in this quadrangle. It has an extended outcrop, is usually more than 15 feet thick, and often contains massive even-grained, buff or gray beds that are suitable for dimension stone. It has been used extensively in the past for all types of construction work and for road metal, and since its outcrop is in many places adjacent to railroads or along improved highways, which provide a ready means of transportation, it is the logical stone to use for all work where strength, durability, and a pleasing appearance are the chief requisites. Occasionally the basal member of the Morgantown is very thick. A maximum of 29 feet was measured in an abandoned quarry at the north end of the Duquesne-McKeesport bridge, but in many other places the same bed is 15 to 20 feet thick. Were it not for the competition of concrete, it is believed the Morgantown sandstone would be in considerable demand for use in the construction of culverts, bridges, chimneys, and permanent types of buildings such as governmental and office buildings. At the present time the Morgantown is being actively quarried about a mile from Monogahela River in the deep valley which almost bisects Rankin. At that point the lower 40 feet of sandstone is quite massive. The stone is used chiefly for foundation walls. It is also being quarried about a half mile west of Sandy Creek, the crushed stone being used for ballast on the tracks of the Verona electric railway.

Birmingham sandstone.

The Birmingham sandstone is very thick and massive in the hills back of Sharpsburg, near Sandy Creek, in McKeesport and vicinity, and in the valley of Long Run. In these areas the beds are massive and occasionally 2 to 3 feet thick; but viewed as a whole the sandstone is much cross-bedded and hence it is difficult to obtain flat pieces for construction work. In most places it is only fit for road metal. Near Piteairn and Unity Station the sandstone is markedly thin-bedded, few beds being more than an inch thick. In 1922 it was being quarried about a mile south of Verona, where the lower 35 feet of sandstone is quite massive. Only the lower 10 feet is being used, however, the upper 25 feet of sandstone being very much cross-bedded.

Saltsburg sandstone.

Occasionally as much as 15 feet of cross-bedded sandstone is found in the interval between the Bakerstown coal and the Ames limestone, but usually the sandstone below the Bakerstown is thicker, more evenly bedded, and hence more valuable. In the southeast part of the quadrangle, the Saltsburg horizon, where exposed, is largely composed of shale. The same condition holds in the vicinity of Homestead and Swissvale; but along Allegheny River, particularly west of Aspinwall, the horizon becomes much sandier. North of Millvale and near Etna the lower part of the Saltsburg is quite massive and ranges from 30 to 40 feet thick. Several quarries have been operated in this vicinity, but they have all been inactive for many years.

Buffalo sandstone.

Where exposed along Brush Creek south of Trafford City and on both sides of Youghiogheny River near Versailles, the Buffalo is a massive, thick-bedded sandstone. But since it occurs at water level, quarrying it would be uneconomical owing to the necessity of pumping the water which would certainly accumulate in the floor of a quarry in either locality. The Buffalo sandstone also outcrops south of Verona, but it is less massive there and is interbedded with shale. Both the Birmingham sandstone and the Morgantown sandstone are superior to it in that vicinity."

To these statements from the Pittsburgh Atlas may be added these from the Sewickley Folio of the Geologic Atlas of the United States.

"Small quarries occur in the Mahoning and Morgantown sandstones at many convenient points along both sides of Ohio River. Most of the stone has been used in the construction of macadamized pikes, as a foundation on which the harder and more resistant limestone is spread. At Stoops Ferry (opposite Sewickley) the Mahoning sandstone strata are rather massive, single beds, measuring 15 feet or more in thickness. A considerable quantity of dimension stone might be secured here and at other places along the north side of the river from Sewickley to Bellevue."

The north bank of the river is so thoroughly built up now that some outcrops accessible when the above paragraph was written in 1909 are no longer possible quarry sites.

Numerous small quarries in the northwest part of the county in the Buffalo, Saltsburg, and Morgantown sandstones formerly furnished material for rough masonry and road building. Nowadays concrete and cinder blocks are used for rough walls and foundations and soft sandstone finds little use in the better class of roads.

Stone Buildings.

To mention all of the larger or better class of stone buildings in Pittsburgh, to say nothing of Allegheny County, is quite beyond the scope of this report. Those mentioned here are the ones that attracted my attention while driving through the city on a main highway and cruising around. Doubtless other churches, public buildings and residences might as well or better have been listed, but I did not come across them in the few hours given to the subject of stone buildings in Pittsburgh.

The Allegheny County Court House (1884)¹ is gray granite from Milford, N. H., and the jail also. The portals of the court house were constructed in 1928, which explains the light color of some blocks near the doorway.

The City-Court Building (1915) is smooth gray granite.

Carnegie Building, Portage "Redstone," from rocks of Cambrian age quarried at Portage Entry on Lake Superior, Michigan.

Frick Building (1900) is notable for the great size of the granite blocks from Maine, now very black with soot from Pittsburgh's heavily-burdened atmosphere.

Other downtown stone buildings or fronts are:

Trinity Cathedral (1870) the main part of which appears to be

¹ Four figures in parentheses are the year in which a building was erected or corner stone laid.

gray sandstone, but part of a rear wing is Indiana limestone. All the outer surface is now so very black as to make recognition difficult.

First Presbyterian Church (1905) is gray sandstone with Indiana limestone trim; all very black with soot except the lower part of the abutments near the sidewalk which have partly scaled.

German Evangelical Church (1925) opposite Gimbel Brothers on Smithfield Street is Indiana limestone, already getting dark, on a granite base.

Mellon National Bank (1923) is New York granite, all darkened except where sheltered inside door and window frames.

Koppers Building (1928) is faced with pink Minnesota granite on the lower stories and Indiana limestone above.

In Schenley Park and Squirrel Hill are many stone buildings, of which the following were seen.

Carnegie Library 1895-1907), Ohio sandstone, stained black by soot-laden air.

Board of Public Education (1927), Indiana limestone, clean because built recently.

County and City Soldiers Memorial Building (1910), Cleveland, Ohio sandstone.

Schenley Park High School (1915), Indiana limestone, fairly clean.

St. Paul's Cathedral (1903), Indiana limestone, lower part much blackened on front side.

First Baptist Church (1910), Indiana limestone, much discolored.

Third Presbyterian Church, looks like Hummelstown brownstone, projecting faces well blackened.

Emory M. E. Church, Highland Avenue, Hummelstown brownstone.

Sacred Heart Church (1926), Shady Avenue, Neshannock sandstone.

Homewood Cemetery Chapel, crematory, etc. (1923), Neshannock sandstone.

Langley High School, Neshannock sandstone with Indiana limestone trim.

Jewish Synagogue, Beth Shalom, Negley Avenue, Neshannock sandstone.

Sixth Street bridge over Allegheny River, Homewood sandstone from Koppel and Curwensville.

Homewood sandstone from Koppel was used also for the bridge over Sawmill Run, east portal of Forbes Street tunnel, bridge over Monongahela River at lower end of McKeesport.

Wilkesburg Bank, polished granite base, white marble above turning yellow.

Wilkesburg Bell Telephone Building (1928), first story Indiana limestone.

Bridgetown. Public School (1904), looks like Hummelstown brownstone. Some blocks in the base have scaled a little and are lighter color. The Bridgetown National Bank looks like Indiana limestone.

Carnegie. First Presbyterian Church is Ohio sandstone all stained very dark, and the high relief is black.

Sewickley. The First United Presbyterian Church is massive coursed ashlar that appears to be native sandstone, looks well though somewhat darkened with soot. Fresher faces under the portico are a

measure of the discoloration of the outer walls. Rubble retaining walls along Hill Street presumably also are native sandstone, perhaps from the ledge that outcrops along the railroad. The Public Library is gray and tan sandstone in 4-inch courses and probably from Ohio.

Ben Avon. A massive sandstone, perhaps the Mahoning, is exposed at the mouth of a ravine and may have been the source of the stone used in old retaining walls here.

Avalon. The United Presbyterian Church (1906) is large and small ashlar, Hummelstown brownstone, much blackened on projecting faces. The stone appears to be in good condition except for slight scaling on the step risers. The Avalon Bank is sawed Cleveland sandstone tinged yellowish, and Trinity Lutheran Church (1917) is gray and tan sandstone perhaps of local origin.

Bellevue. The Methodist Episcopal Church (1906) is notable because it is one of the rare buildings of serpentine in the western end of the State. It is a good illustration too of the unsuitability of this stone for use in an acid atmosphere. The serpentine is in rock-face, random ashlar, and the trim is sawed Cleveland sandstone. In general the serpentine has weathered to a yellowish-green, but the surface of some blocks has sealed off, exposing a fresh green. Many blocks have deteriorated so at the surface that scales can be picked off and sand rubs off easily. The Sunday School addition (1926) is from the same Chester County quarry and looks very nice in 1929, the bright green serpentine walls contrasting well with the gray Ohio sandstone trim, but it is almost certain that in a few years the serpentine in the addition will have faded to the same unattractive color as the church.

The Church of the Epiphany (1887), Bellevue Methodist Protestant Church, and several others in Bellevue are built of gray sandstone but they have accumulated soot until most of the masonry can be described as "black as your hat." A well exposed cliff of massive sandstone at the mouth of a ravine at the east end of Bellevue may have been the source of some of the sandstone used locally.

Allegheny. The stone buildings that have been standing a few years and have not had an exterior cleaning are all so blackened with soot that it requires close examination to distinguish between sandstone, limestone, and granite. In this condition it is rather footless to name individual buildings for the masonry looks all alike.

Tarentum. The Central Presbyterian Church is Hummelstown brownstone in good condition. Two banks here are faced with Indiana limestone.

ARMSTRONG COUNTY.

Armstrong is on Allegheny River above Pittsburgh and lies between Indiana and Butler counties. It was named for General John Armstrong, of Pennsylvania, who commanded the expedition against the Indians at Kittanning in 1756. Kittanning, the county seat, is on the site of an Indian village of that name, meaning "greatest river," or "the main stream."

The rocks exposed in this county include the geologic section from the Pocono sandstone to the Pittsburgh coal. The Allegheny and Conemaugh groups occupy most of the surface. The Pocono and Pottsville sandstones, which in this region are not separated by the Mauch Chunk shale, are above water level along Allegheny River from just above

the mouth of Mahoning Creek to near Phillipston, below Redbank Creek. At the mouth of Redbank Creek the top of the Pocono is about 150 feet above water and it keeps above the creek for several miles to Anthonys Bend. It is well exposed in the bluff south of Leatherwood, at the tunnel west of Leatherwood, and above the east end of the Climax tunnel. The Pocono is exposed also on the lower end of Mahoning Creek and on the upper part of the creek above McCrear Furnace.

The Pocono at the mouth of Redbank Creek is about 150 feet of coarse, thick-bedded to massive, gray to greenish sandstone.

The Pottsville group is composed of three members, the Homewood and Connoquenessing sandstones, and the Mercer shale between them. The sandstone members are each about 40 feet thick and the dark shale 20 to 40 feet. The sandstones are gray, massive, highly siliceous, and may be coarse-grained or contain pebbles. They may be flaggy or shaly in places. The distribution of the Pottsville is much like that of the Pocono just described, but the top of the Pottsville, the Homewood sandstone, rises above the Allegheny opposite Wickboro, the northern suburb of Kittanning, and though gaining an altitude of 100 feet above the river, falls below it near the mouth of Cowanshannock Creek. The Homewood and Connoquenessing sandstones, both coarse and massive, are exposed in the river bluffs from Templeton north, in some places forming conspicuous ledges. At the mouth of Mahoning Creek the bottom of the Pottsville is about 75 feet above the river and the two sandstones are conspicuous at several places up this creek, though the Homewood in places is shaly. They are in the bluffs on Redbank Creek from its mouth to New Bethlehem and are well exposed around Climax. They occur also at Craigsville in the western part of the county.

The Clarion sandstone, a coarse, thick-bedded member at the bottom of the Allegheny group, occurs in the bed of Cowanshannock Creek one mile above its mouth, at the south end of the bridge at Mahoning Furnace, one-half mile south of New Bethlehem and elsewhere.

Between the Vanport limestone and Lower Kittanning coal is the Kittanning sandstone, a coarse, heavy-bedded stratum 20-40 feet thick that is well exposed on the north side of Cowanshannock Creek near its mouth, has been quarried in the river bluff above the clay mine at the mouth of Cowanshannock, and makes a bold ledge along the west bank of the Allegheny from opposite Ewing to above Mosgrove, and opposite Rimer in the top of the river bluff.

A quarry in this sandstone 0.3 mile north of the Cowanshannock and above a grade crossing on the river bank is about 200 feet above the river and directly over a clay mine. The quarry face about 400 feet long has been developed on a 30-foot ledge of massive gray sandstone, part of which is ferriferous. Stone has not been quarried here in many years. A sand mill is said to have been operated on the waste 20 or more years ago. This quarry likely was the source of much building stone used in Kittanning.

The Kittanning, Freeport, and Butler sandstones are conspicuous in the bluffs on Crooked Creek below South Bend. The Kittanning sandstone was quarried at Girty many years ago for flagstones and tombstones. It separates easily into large smooth layers from 1 to 5 inches thick.

The Freeport sandstone, lying between the Upper Kittanning and Lower Freeport coals is described by Butts as follows:¹

“It is a more persistent stratum than any of the other sandstone members of the Allegheny formation. In character it varies from laminated or flaggy and fine-grained, as at Weskit, to coarse, massive, and conglomeratic, as in the vicinity of Worthington, where it is at least 50 feet thick. It is well developed along Buffalo Creek. At Boggsville it is the heavy sandstone at creek level at the east end of the village. Below the mouth of Marrowbone Run it rises as a ledge 20 feet or more above the water of Buffalo Creek. In the vicinity of Buffalo Mills, Worthington, and Craigsville its presence is made known by the large masses of a conglomeratic sandstone that strew the surface. At the head of the ravine running from Worthington to Buffalo Mills it is exposed 50 feet thick. In the hills northwest of Craigsville it is heavy and yields masses 15 to 20 feet high. Near Fosters Mills it crops out in conspicuous ledges. It lies at the surface over the high, flat ridge in the southeastern part of Sugar Creek Township, and has been the controlling factor in the formation and preservation of that surface. The large boulders of coarse sandstone and conglomerate at Somerville come from the Freeport sandstone, which also furnishes the boulders along Buffalo Run 1 mile east of Rattigan. It is well developed on the high knobs in Madison Township south of Redbank Creek. It is particularly heavy and conspicuous, apparently 40 to 60 feet thick, at the head of a ravine south of Mahoning Creek, about 1 mile east of the northwest corner of Wayne Township. On the north side of Mahoning Creek, opposite the mouth of this ravine, great masses of sandstone occur near the top of the bluff which probably come from this stratum. The Freeport sandstone shows in good thickness in a ravine east of Templeton. It is coarse and heavy at the mouth of Bullock Run, where it rests upon the Upper Kittanning coal, and at Pine Furnace, where it is in contact with that coal or closely overlies it. The large blocks of coarse conglomeratic sandstone on the hillside above the old mill on Cowanshannock Creek near the margin of the Kittanning quadrangle come from the Freeport sandstone, which also outcrops on the west side of the hill high above the river. This sandstone shows along the bluff between Kittanning and Garrett Run. It is extensively exposed and quarried on Garrett Run about 1 mile above its mouth, where it is about 40 feet thick, and along the railroad between the southern margin of the quadrangles and Kellys Station.”

The Butler sandstone, between the Freeport coals, is a coarse-grained, massive bed that makes bluffs and strews the surface with large blocks. It is notable in the railroad cut 1 mile north of Boggsville, at Walkchalk, and in the vicinity of Deansville where it is at least 20 feet thick and conglomeratic. It is massive and has resisted erosion on the hill northwest of Deansville and rims the steep bluff of Mahoning Creek south of this place. In other places also it is massive but only 10 feet thick, or it may be thin-bedded. Any quarrying in this bed has been on a very small scale for home use.

The Mahoning sandstone usually closely overlying the Upper Freeport coal is medium-grained and thin-bedded in some places, and in

¹ Butts, Charles, *Economic geology of the Kittanning and Rural Valley quadrangles, Pennsylvania*: U. S. Geol. Survey Bull. 279, pp. 35-36, 1906.

others, coarse-grained and thick-bedded. It has this latter character and is nearly 40 feet thick in an old quarry across the river from Ford City, and along Glade Run from North Buffalo nearly up to Walkchalk, and on Cornplanter Run west of Boggsville. In the river bluff about 2 miles north of Mosgrove, and near the top of the hill 1 mile northwest of Putneyville, this sandstone is 50 feet thick. It forms the top of the bluff at Cochran Mills. Large blocks of coarse Mahoning sandstone strew the surface in the western part of Mahoning Township, and between Stone House and McNeese in Valley Township. This sandstone outcrops in ledges elsewhere in the county but is flaggy and not suitable for building stone.

Higher sandstones similar to those already described are found in the higher hills, as between Buffalo Creek and Sipes Run 2 miles north of Boggsville, and along the ridge road between Templeton and Goheenville, but they may be friable and weather to small fragments, and rarely are hard.

Stone Buildings.

Kittanning. One of the older stone buildings in Kittanning is the County jail built in 1870-73 of massive, dressed-faced, coursed ashlar. The stone is gray siliceous sandstone, of medium coarse grain, and some cross-bedded, in blocks up to 14 inches by 5 feet. Mr. James McCullough, Jr., president of the Safe Deposit & Guaranty Trust Company of Kittanning, who superintended building the jail, told me that the stone was shipped in, received in rough blocks, and was dressed on the job by Scotchmen. The stone came from Catfish, Clarion County, on the Allegheny 3 miles above East Brady. It seems to be in sound condition.

The Court House, built in 1858-60, is of stone below and brick above. The source of the stone was not learned but presumably it is from some quarry in the Coal Measures along the Allegheny within a few miles of Kittanning.

The First M. E. Church (1909) looks like Hummelstown brown-stone; it is fairly clean and in good condition except for cracks caused by an insecure foundation.

The First Presbyterian Church (1910) is mainly a coarse, siliceous sandstone of slightly reddish hue, trimmed with similar gray sandstone. It is rather soiled, as might be expected after 20 years exposure to soft coal smoke. The stone is said to have come from a quarry at the mouth of Cowanshannock Creek. The sandstone slab bearing a tablet, at the end of the Allegheny River bridge in Kittanning, is from this same quarry. The fronts of several stores, banks, the City Hall, etc., in Kittanning are native sandstone, from this or some other near by quarry.

Ford City. The largest stone structure in Ford City is St. Mary's Roman Catholic Church (1912) which is siliceous sandstone in rock-faced random ashlar, trimmed with Indiana limestone. The sandstone came from the Hilty quarry at Apollo. The fine appearance of this building is due in part to the fact, as told me by a stone cutter, that the face stone were all selected; any stone showing pyrite was rejected for the face and used as backing.

The Presbyterian Church (about 1900) is gray to yellow sandstone quarried in the bluff back of town. Much of the stone is smoke-stained

but some blocks around windows and doors are clean and yellow, due to sealing.

Freeport. The only all-stone building seen is Trinity Evangelical Lutheran Church (1926) which is variegated gray and buff Indiana limestone veneer. Foundations and walls of sandstone in other buildings are from old quarries at the upper end of town.

Leechburg. The First Lutheran Church is brownstone; the others are brick on native sandstone foundation.

Apollo. The front of one bank is Indiana limestone and the Presbyterian Church is local sandstone. This stone, as well as the curb-



Fig. 15. Presbyterian Church, Apollo, Armstrong County, built of Mahoning sandstone. Photo by Geo. H. Ashley.



Fig. 16. Typical exposure of Coal Measure sandstone (Mahoning) near Apollo, Armstrong County. Photo by Geo. H. Ashley.

ing in Apollo, came from a quarry about half a mile from the Kiskiminetas in the valley of a small stream south of Apollo. It is the largest building stone quarry in the vicinity and produced a large quantity of rough and dressed stone for local use and for shipment to near by towns and cities. The quarry face is about 40 feet high on a 25-40-foot ledge of massive light gray to brown sandstone. It has not been operated for several years, and a heavy overburden of thin sandstone and shale would retard further development. This is the Mahoning sandstone.

The Butler, Freeport, Saltsburg, and Morgantown sandstones have been utilized in the rural districts for foundations of farm buildings, and are wholly suitable and abundant.

BEAVER COUNTY.

Commonly a large river becomes a county boundary but not so with Allegheny and Beaver counties. Each is divided into three parts by rivers. Beaver County lies on both sides of Ohio River on the western boundary of the State. The rocks exposed in this county extend from the Pottsville conglomerate to the Pittsburgh coal, and are largely the Conemaugh and Allegheny groups. The Homewood sandstone or upper member of the Pottsville group is exposed along Beaver River from Beaver Falls north to the county line at the mouth of Connoquenessing Creek. The other sandstones, including the Freeport, Butler, Mahoning, and Morgantown, are more widely distributed, except the latter which is present only in the southern part of the county.

Homewood sandstone.

The only sandstone in Beaver County that is quarried regularly now is the top of the Pottsville group, called the Homewood sandstone from its occurrence at that small settlement a few miles north of Beaver Falls. This sandstone rises above the river at New Brighton and makes bluffs along the river up to Wampum.

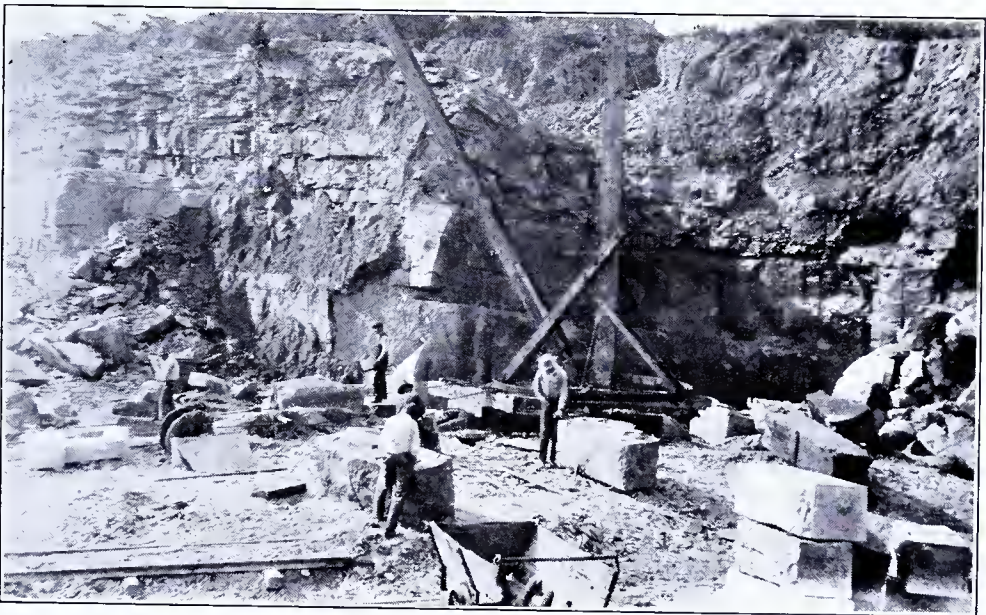


Fig. 17. Homewood sandstone quarry, Koppel, Beaver County. Shows thick bedding and large blocks for bridges.

This bluff is all Homewood sandstone where it is less than 50 feet above the river, but where it is much higher, as at Homewood and Koppel, the underlying Connoquenessing sandstone also is above river level. It is the Homewood, however, that is quarried. Where of value the Homewood is massive-bedded, tan to gray, coarse-grained sandstone 20 to 60 feet thick. It was formerly quarried at the mouth of Bennett Run and Thompson Run just north of Beaver Falls, and at Homewood and Bellton. The present operation is at Koppel where the Ellwood Stone Company of Ellwood City, has a large quarry. Here a massive sandstone ledge 30 feet thick, outcropping about 150 feet above the river has been worked for many years for the massive stone used in railroad bridges. The quarry face is nearly 1,500 feet long and as joints in the main ledge are far apart, blocks of any desired size, up to the capacity of a crane to handle, can be produced. Heavy blocks about 2 feet thick, 30 to 36 inches wide, and 3 to 6 feet long



Fig. 18. Making curbstone from Homewood sandstone, Ellwood Stone Co. quarry, Koppel, Beaver County.

for bridge piers and abutments, for large retaining walls, and extra large foundations are readily produced in quantity at this quarry. From 50 to 120 men are employed, depending on the orders on hand. Curbing also is made here, the common size being 6 by 22 inches, with a minimum length of 4 feet. From 500 to 1,000 feet of curbing can be made per day. Compressed air is used for drilling, and four power cranes handle the blocks from quarry face to railroad car. The quarry is on the Pittsburgh & Lake Erie Railroad and has direct connection with the Pennsylvania Railroad.

The thin-bedded sandstone overburden and the spalls from the quarry are made into silica sand at a plant on the bluff below the quarry. Stone from this quarry was used for some of the arches in the Market Street

bridge, Harrisburg (1927), bridge between Rochester and Monaca over Ohio River (1928), part of Sixth Street bridge over Allegheny River, Pittsburgh (1927), the bridges over Allegheny River at New Kensington, over Monongahela River at the lower end of McKeesport, and over Sawmill Run in Pittsburgh, and in many railroad and other bridges in the Pittsburgh district.

Freeport sandstone.

A moderately coarse, micaceous gray rock occurring normally above the Upper Kittanning coal occurs in some areas; in others no sandstone is found at this horizon. Places where it outcrops are from New Brighton to Fallston, around Rochester and Monaca through Dam No. 5, and in the north bluff of the Ohio from Vanport westward. It thickens down the river and below Industry has a thickness of 140 feet, but near the State line is not over 75 feet. The outcrop extends up Raccoon Creek to the mouth of Gums Run. It makes a bluff showing 30 feet of thin-bedded sandstone at the mouth of Crows Run below Conway.

The stone is hard and micaceous but has been little used for building stone, perhaps because it does not dress readily in some directions. The only place where it has been worked is in the steep bluff between Industry and Midland, and this operation was many years ago for the Pennsylvania Railroad. The tracks and the highway crowd the base of the bluff and quarrying at this site would be rather impracticable now.

Butler sandstone.

Lying between the Upper and Lower Freeport coals, this sandstone also is sporadic in occurrence. It ranges from 0 to 40 feet thick and is present on Brady Run and Beaver River. Where typically developed it is a coarse-grained, yellowish-white rock and well suited for building stone. Because of this fact and its proximity to the communities, it was quarried 20 or 30 years ago east of New Brighton, on Blockhouse Run, just below the mouth of Brady Run, and in the hill back of Beaver Falls. These quarries have long been idle. The Butler sandstone is gray, locally massive, and 10 to 30 feet thick on Brush Creek in the vicinity of Unionville and Oakgrove.

Mahoning sandstone.

Directly overlying the Upper Freeport coal is the Mahoning sandstone, which is the basal member of the Conemaugh group. It is coarse-grained, generally yellowish to brown, and in some places contains small white quartz pebbles. This sandstone is not everywhere present, giving way in places to shale; but where it is present and more than a few feet thick it makes a resistant ledge. This ledge caps the bluffs of Ohio River and rims some of the lateral streams. It follows up Mill Creek and underlies Hookstown; and extends up Raccoon Creek to Independence.

This stone has never been much worked in the western part of the county where it tends to be conglomeratic. In the eastern part, however, old quarries in this sandstone can be found in the river bluff west and south of Monaca and around Rochester. As recently as 25 years ago quarries were worked in this sandstone north of Rochester. Older operations were on Blockhouse Run and on Sixmile Run.

The Mahoning sandstone was quarried on Crows Run at a place called Parks Quarries, 1½ miles east of Freedom, but as stone has not

been taken here in 20 years or since about 1910, the four old openings are somewhat overgrown. I was told that blue and gray sandstone suitable for all purposes including curbing came out of this place in blocks up to 100 cubic feet in size. Of this locality Munn says in the Sewickley folio (No. 176), U. S. Geological Survey, 1911:

“One of the most extensive quarries in the Mahoning sandstone member is at Parks Quarries, on Crows Run, where an immense amount of low grades of building stone has been extracted. Some of the strata are from 2 to 10 feet in thickness, split readily into blocks, and apparently dress easily. The sandstone is coarse, somewhat conglomeratic in places, and gray to yellowish in color. For years this quarry furnished a large quantity of stone to cities and towns on Ohio River from Beaver to Pittsburgh, but in the last few years the output has greatly diminished. This is probably due, partly at least, to the greater difficulties encountered in stripping, and partly to the fact that cement is increasingly taking the place of the stone formerly used in building.”

Sandstone was quarried in Conway on Third Avenue until about 1914.

Morgantown sandstone.

As the top of this sandstone is about 125 feet below the Pittsburgh coal, and that coal occurs only along the southern line of the county, the sandstone is present only in the southern part of the county. It ranges from 65 to 100 feet thick and from massive to thin-bedded. It is rather soft and is said to become more friable on exposure. Being in a thinly settled agricultural district it has been used only in a small way for rubble foundations of farm buildings. It is possible that search in the massive beds might disclose places where good dimension stone could be taken, but there is little likelihood of a demand for it.

Limestone.

Although there are several beds of limestone in this county, so far as observed none has been used for building stone. Only one limestone bed, the Vanport, is more than a few feet thick, and it is very irregular and in places is absent. It is 10 feet thick at Fallston, and 16 feet or more at Vanport. Elsewhere it is much thinner. This limestone is fossiliferous, brittle, some beds are gray and some blue, and may have a reddish tinge.

Stone Buildings.

Beaver. Beaver County had a stone quarry in the earliest days of its settlement. Hon. Alexander Addison, president judge, wrote to Governor Mifflin February 3, 1796 in regard to laying out Beaver and suggested that land should be reserved around a spring. “There is also a stone quarry near it, which ought not to be suffered to become private property.” Also the judge referred to providing for a “proper road from the stone quarry.”¹

Perhaps the earliest stone building was a jail, for in Bausman's history (page 628) it is recorded that a visitor to Beaver in 1807 wrote “There is a stone goal not quite finished, which was the only publick building we noticed.” The present jail at Beaver is built of gray sandstone in smooth, coursed ashlar and so is not black with soot so

¹ Bausman, Rev. J. H., History of Beaver County, Pa., vol. II, pp. 616-17, 1904.

common on rock-faced walls. The source of this stone may be local, for the jail and sheriff's residence was built in 1856-58, before building stone was shipped in from any distance.

The First Presbyterian Church (1890) is gray sandstone but includes some blocks with a reddish tinge, all in rock-faced, coursed ashlar. It looks like an Ohio sandstone. Blocks with high relief are stained black, but the base courses are fairly clean, perhaps due to flaking of the soiled surface. A yellow brick house across the street built in 1929 has its foundation veneered with 3-inch variegated yellow, light tan, and reddish Ohio sandstone.

The First United Presbyterian Church (1904) is Hummelstown brownstone. It has not become deeply soiled and the stone looks to be in good condition. The base of the Court House is sawed gray to tan sandstone probably from Ohio.

Beaver Falls. Farmers National Bank (1929) and Beaver Valley Water Company office building are Indiana limestone. The First Presbyterian Church (1929) is garnetiferous mica schist from the Foxcroft quarry at Broomall, Delaware County, with Indiana limestone trim.

St. Mary's Church (Protestant Episcopal) was built in 1875 of sandstone quarried in the bank of Beaver River above town and presumably is Homewood sandstone. Recent additions are similar stone from near the river and from a hill at the upper end of town. The blocks are coursed, rock-faced ashlar. The original building is very black with soft coal soot. Stones from the original wall that were redressed for use in the additions are tan colored. The new masonry is gray, tan, and reddish sandstone. All of the stone is in good condition. Set in the wall of the vestibule is a block of marble about 1 by 2 feet from Westminster Abbey, a gift to the present rector. This marble was built into the abbey in 1290 and removed during recent alterations. The wall at the end of the street by St. Mary's Church is made of curbstone discarded by the city. They are presumed to be Homewood sandstone from a nearby quarry.

Geneva College (1880) in College Hill Borough is a native gray sandstone now much darkened with coal soot.

New Brighton. Presumably the curbstones and older stone foundations of buildings are of Freeport or Butler sandstone quarried near the town. A church and the base of a school were noted as being of stone by they are so pot black with smoke of many years that their character and source was not investigated.

Rochester. Grace Lutheran Church, built first of cobbles, then brick, and rebuilt in 1907 probably of native sandstone is trimmed with sawed Ohio sandstone. A balustrade of Indiana limestone surrounds the front terrace. The blocks of local sandstone with high relief are stained black.

The First Baptist Church, built in 1874, rebuilt in 1916, is gray siliceous sandstone believed to be Homewood from some quarry on Beaver River. It is not yet so much discolored as Grace Church. The piers of the bridge over Ohio River between Rochester and Monaca are Homewood sandstone from the quarry of the Ellwood Stone Company at Koppel.

Ambridge. Brick buildings predominate here, but two banks and Loughlin Memorial Library are Indiana limestone.

Aliquippa. Woodlawn Trust Company, Aliquippa National Bank, and B. F. Jones Free Library appear to be Indiana limestone. Smoke from large industrial plants in these river towns tends to blacken all stone work within a few years, except fairly smooth surfaces that rain washes clean.

BEDFORD COUNTY.

Bedford County on the Maryland boundary is a mountainous area containing some of the most complicated geologic structure in the State. Although Bedford has 1,026 square miles, only 8 less than Somerset County which bounds it on the west, it has less than half the population, or 37 people per square mile as against 80 in Somerset County. Early settlers did not build stone houses, even where hillsides were covered with loose rock suitable for building purposes, probably because timber was everywhere abundant. To this day, stone buildings are rare.

In Bedford small use has been made of the "mountain sandstone" or loose blocks of Oriskany and Medina sandstone found on the neighboring hillsides. King's garage at the intersection of the Lincoln High-

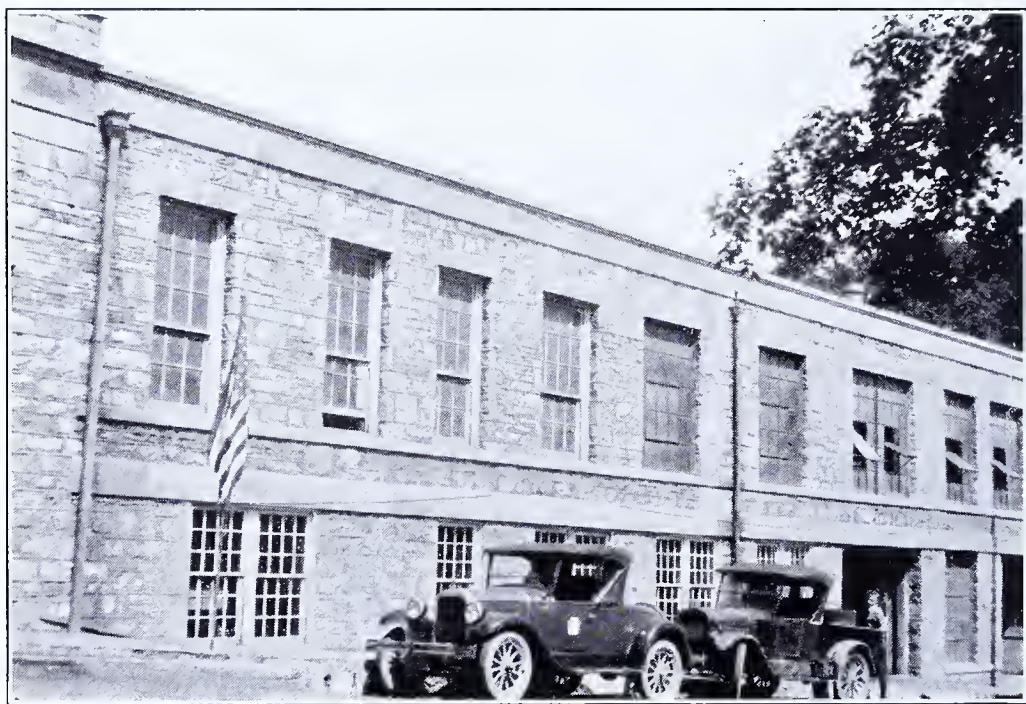


Fig. 19. Helderberg limestone and mountain stone, King's garage, Bedford.

way and Horseshoe Trail is faced mostly with this mountain sandstone but includes limestone from the basement excavation. Laid in random ashlar and well pointed the buildings has a neat and substantial appearance.

The Protestant Episcopal Church (1866) in Bedford is of Helderberg limestone, on which the town is built. I did not learn the exact source of the stone; may be it came from the quarry on the north bank of the creek along the Horseshoe Trail. All the blocks are weathered to gray but some are lighter than others. The stone is

banded, and some blocks are gnarly. Many blocks are laid on edge and some show incipient cracks. The main door is framed in hand dressed blocks. The stones in the walls are of odd size and shape, but the door sill 7 feet long, 2 feet wide, and 6 inches thick suggests that the walls could have been built of large and regular stones, had that been desired.

The Bedford High School built (1924) of brick, has a good foundation of mountain sandstone, random ashlar, blocks 4 to 8 inches thick, pointed with gray mortar. The general color is gray but some blocks are stained tan in irregular blotches. A house across the street has a fireplace, chimney, and posts of the same stone but pointed with black mortar.

A mason laying a rough stone foundation said there is no building stone quarry near Bedford; they "just gather float blocks or use old stone walls."

The Medina sandstone has been quarried extensively at Wolfsburg, 3 miles west of Bedford, for ganister. Vertical joints and horizontal bedding produce roughly rectangular blocks, but I have not observed this gleaming white stone used for building purposes.

This same sandstone makes large rock floes on Tussey Mountain, and in the Yellow Creek gap just east of Loysburg where a floe borders the highway the Pennsylvania Highway Department crushed the float rock for road metal. As this rock is hard and almost pure silica it would make a durable building stone, although it might not dress easily. In rural districts it would retain its whiteness many years. This stone has been quarried for ganister in the Juniata River gap just east of Bedford, and in two places on the west side of Wills Mountain.

On the Lincoln Highway 1½ miles west of Wolfsburg at the road to Mamms Choice is a large old stone house which I recall as being dark sandstone. It is about on the outcrop of the Oriskany sandstone and Helderberg limestone.

There are limestone quarries in many parts of the county, opened for flux, lime, and agricultural uses, that might furnish building stone. Limestone has been used for house and barn foundations in some localities where it outcrops. The stone is durable and weathers from dark to gray or dove color.

Two large limestone quarries have been operated for years at Everett and Hyndman. The former is said to have been worked for 100 years. It contains mostly a gnarly blue stone and is worked for road material. This quarry at Ashcon, just west of Everett, was operated for many years by the Thropp Iron Company for flux. The stone is dark blue to black and weathers to bluish gray. Some of the beds are massive, and, where not too closely jointed, would yield large blocks. They dip E. 45°. The quarry is about 900 feet long, 150 feet wide, and 70 feet deep. In 1924 when I visited the quarry the State Highway Department was beginning to lower the floor 45 feet.

The Enterprise quarry by the B. & O. R. R. bridge over Wills Creek at the north end of Hyndman has a face 400 feet long and 80 feet high in massive beds of Helderberg limestone standing on edge. In 1928 the kilns were idle and the product was sold crushed for railroad ballast and highway use.

At Napier directly on the Lincoln Highway is another quarry operated for crushed stone which exposes Helderberg beds dipping at high angles. Close jointing and thinness of beds make most of the quarry product suitable only for crushing but near the middle of the face are thicker beds from which building stone could be obtained.

Sandstone suitable for building purposes can be had from massive Pocono and Medina beds, and from the thinner-bedded Portage flags. The Medina is likely to be tough and hard to dress, and the Portage beds yield stone that is easily trimmed but it turns to a dull brown. The Oriskany sandstone has been used in a few places but the stone must be selected to get durable material. Two houses at Schellsburg may be of this stone which outcrops at the village. One house on the north side of the Lincoln Highway is of large squared blocks and was built many years ago. The stone has weathered to a yellowish hue and some blocks are much cracked. Opposite is a new house (1925) of rock-faced, dressed stone mostly a light tan but with some pink and gray blocks.

BERKS COUNTY.

Berks is one of the larger counties in the State (865 square miles) and is comparable with Washington County, both in size and density of population. Reading, the county seat and principal city contains over 110,000 people, is a large manufacturing center and the hub from which radiate the several lines of the Reading Railway System and Pennsylvania Railroad. The Schuylkill River crosses the county from north to south.

Berks County is surpassed by no other county in the variety of rocks contained within its border. Here are found granite, gabbro, diorite, granodiorite, diabase, basalt, pegmatite, schist, limestone, shale, sandstone, quartzite, and conglomerate. The northeast-southwest parallelism of formations is less noticeable than in many other counties. The Triassic red beds occupy the southern part. Limestone formations in a wide valley cross the middle of the county, and Martinsburg shale underlies the northern part of the county, with Medina sandstone along Blue Mountain. These areas, however, are irregular and much interrupted by small areas of other rocks. Various granitic rocks interspersed with Cambrian quartzite make South Mountain east of Reading and along the county line west of Wernersville.

In somewhat more detail the distribution of the geologic formations is as follows: The extreme southern point of the county is on Welsh Mountain which is Chickies quartzite, a rock which in some places is ground for silica sand, and in other places is quarried for building stone, but is not utilized in this particular area. Morgantown, the southernmost village in the county is in the midst of a limestone belt, north of which lies a broad area of Triassic sediments, red and brown sandstone and shale extending to Shillington, Mohnton, Neversink, and Amityville. Intruded in these beds are some considerable areas of diabase. One belt crosses Caernarvon Township, and another belt extends almost continuously for several miles from Mohnton along the south side of the Schuylkill through Gibraltar Hill and Sheep Hill, to Birdsboro and Monocacy. This hard black rock is quarried very extensively for crushed stone and has been used in some localities in this county for building stone, although its somber color makes it less desirable than some other native products.

A belt of limestone very irregular because of much faulting underlies the lowland from Boyertown through Greshville to Yellow House, and westward through Jacksonwald to Reading and Shillington. A broader area of limestone extends from Yellow House north to Lobachsville, and a broad belt occupies the valley of Maiden Creek and all the lowland from Farmington through Kutztown, Fleetwood, Temple, Reading and westward to the Lebanon County line near Stouchsburg and Newmanstown. West of Reading the broad belt of limestone is interrupted by a number of narrow infolded belts of Martinsburg shale. The limestone in these belts is all of Cambrian and Ordovician age. Much of it weathers to a light gray, although some beds contain more or less shaly material which weathers to a light brown. This stone has been used extensively throughout all this belt for building purposes, beginning back in the Colonial days and extending to the present. Examination of many old buildings including farm houses, grist mills, and barns has failed to show any deterioration on the part of this limestone. Its durability together with its pleasing color when weathered make it a desirable building stone for local use. It can be obtained in blocks up to a foot thick, but more commonly it makes 6 to 8 inch ashlar. The difficulty of dressing the stone to smooth faces makes it unsuitable for commercial shipments.

The South Mountain belt which is widely separated into two areas by the Schuylkill valley is composed of a very intricately faulted mixture of granitic rocks and Cambrian quartzite. These rocks are mostly granite, but with the granite is included small areas of dark coarse-grained gabbro, lighter granodiorite, and attenuated segregations of gneiss. These coarse-grained rocks are cut by long narrow dikes of diabase and throughout the whole mountain area are found numerous patches of Cambrian quartzite of all conceivable shapes and sizes. These mountains have been the source of considerable building stone for use in their immediate vicinity, although so far as discovered no quarries at present are actively engaged in producing stone for building purposes. Many houses and retaining walls in the vicinity of Mt. Penn, and the dam at Antietam Reservoir are built of local granitic rocks. Several of the summer resort hotels on South Mountain near Wernersville, including South Mountain Manor, Galen Hall, Britonwood Inn, and Sunset Inn, are built of very coarse-grained granite gneiss obtained from the outcrops or by breaking up surface boulders.

In the broad belt of Martinsburg shale which extends across all the northern part of the county, the principal building stone is a hard gray sandstone which occurs in the shale formation. Only one quarry was observed in this area which had produced any considerable quantity of building stone, and it is located just north of Virginville. Its present product is crushed stone. Throughout the rest of the area any building stone that has been taken from this formation has come either from surface float or from very small openings.

The massive Medina sandstone makes Kittitamy Mountain and the whole northern boundary of the county. As the south slope of the mountain in places bears heavy talus of this rock, (see Fig. 20), it has been unnecessary to open quarries in order to secure building stone for farm houses near the mountain. This stone is very durable and freshly broken rock shows gray, pink, and tan colors which blend well in a wall and are retained for many years.



Fig. 20. Medina sandstone, "mountain stone" float, at "Blue Rocks," 2 miles northwest of Lenhartsville, Berks County.

Stone Buildings.

Buildings of Triassic sandstone. Two particularly historical buildings in Berks County are the Lincoln and Boone houses near Birdsboro. About 2 miles northwest of Birdsboro on the north side of Schuylkill River is the Lincoln house built by Mordecai Lincoln, great-great-grandfather of Abraham Lincoln, about 1723. This house is built mostly of red Triassic sandstone, is heavily whitewashed, and in a good state of preservation except where mortar has worked out in the foundation. The building stone is still good. The upper and smaller end of the house was built first and presumably of field stone.

The Daniel Boone house $1\frac{1}{2}$ miles north of Baumstown when seen in 1924 was abandoned and in a dilapidated condition. It is said to have been built about 1730. The east half is of brown sandstone and the west half is mixed brown sandstone and diabase. The stone shows little or no sign of weathering and should be good for another century or more. The stone door sill is worn hollow, but this would be expected.

Another old house is that at Gibraltar, at the mouth of Allegheny Creek, where gray Triassic sandstone was used in the main walls and brownstone for the trim of a 2-story house built in 1787. This stone and that in the near by mill which may be an even older building appears to be in good condition.

From Gibraltar through Birdsboro to Pottstown, many farm houses are built of gray or brown Triassic sandstone, and in Birdsboro a Methodist Episcopal Church, several houses, and retaining walls are of brownstone rubble. A particularly good masonry job is the brownstone ashlar retaining wall of the cemetery at the east end of Birdsboro. It is understood that all of the brownstone used in this vicinity came from float rather than from a quarry.

In the vicinity of Vinemont, red sandstone buildings and walls are common. An old resident says that there is no quarry in the vicinity, but all of the building stone has been obtained by breaking up surface rocks. Near this village is the headquarters of the Boy Scouts of America, known as Indiandale. The property includes a

large 4-story building of Triassic sandstone laid as random ashlar, part pointed in black, and part in red. Reddish quartz pebbles are common in the sandstone. The retaining walls are of the same stone laid as rubble, but include some gray sandstone. In Adamstown also are some old red Triassic sandstone buildings, including one dated 1820 which is in fine condition.

The Lutheran Church at Straubstown is all massive coursed ashlar. The foundation is of gray Triassic sandstone and conglomerate, and



Fig. 21. Triassic gray and brown sandstone and conglomerate from old Union Canal locks. Lutheran Church, Straubstown, Berks County.

the rest of the building brown conglomeratic sandstone. It was built in 1895, and the stone is said to have been taken from locks of the abandoned Union Canal.

The Evangelical Lutheran Church at Bernville (1897) consists of brownstone said to have been obtained near Mohnton, and the St. Thomas Reformed Lutheran Church (1897) at the same place has a brownstone conglomerate foundation and upper walls of gray sandstone. The latter stone is believed to have come from near the Plow Church north of Morgantown. This is a good looking stone when fresh, but in a few years some blocks stain black and others do not, thus detracting from the general appearance.

Other sandstone buildings. Perhaps the most extensive use of stone in buildings on any farm in the county, is on the west bank of Maiden Creek just north of Virginville. The Leiby farm buildings are built almost entirely of gray, black, and buff weathered stone from an old quarry near by. A tablet over the front door is marked 1829. An interesting feature of the house, huge barn, and five other buildings is the size of the sandstone slabs, many of which are several feet long. The wall in front of the house is capped with single stones 8 inches thick, 24 to 26 inches wide, and up to 20 feet long. The paths are

paved and the garden beds are outlined with thin slabs so very long as to be extraordinary. This stone is a sandstone member of the Martinsburg shale formation.

The Bethany Methodist Church (1913) at Hamburg is of rough "mountain" stone, laid as rubble rather than ashlar. It shows considerable color including purple, gray, and iron stained, but some might think the surface too rough for a church. Large quantities of Medina float are available in several places on the mountain front and if the color does not fade quickly this should prove to be a desirable building stone.

Buildings of Cambrian quartzite. The Berks County prison in Reading, built in 1874, has a front face and tower of brown Triassic sandstone and conglomerate, but other walls are drab quartzite probably from the side of Mt. Penn. The pagoda on Mt. Penn is of this same quartzite from the quarry just below it. This quartzite generally is gray and some of it contains small pebbles. On the crest of the hill 3 miles southwest of Pricetown, Cambrian quartzite and sandstone taken from a rock slide near by was used in 1926 for a house and retaining wall. Some of this quartzite, sometimes called "water stone" because of the colorless character, has a pink tinge which gives a very pleasing color effect, as illustrated by this house.

In other areas where this quartzite outcrops, as near Fredericksville, an occasional barn and house foundation is seen in which float quartzite was used. It retains its reddish to purple color for many years.

Limestone buildings. Old buildings of the native limestone are too numerous to mention. Several limestone houses in Shillington are of stone from the Fehr & O'Rourke quarry on the Laneaster Pike. Although this quarry is operated for crushed stone, some of the upper beds split nicely and are sold for building stone. The Mohnton Trust Company Bank at Mohnton and the Fire Hall at Fifth and Chestnut Streets, West Reading are blue limestone from the Glenside quarry at the mouth of Tulpehoeken Creek. The wall of the city reservoir across the street from Berks County Prison is gray and black-banded limestone taken perhaps from the reservoir site.

The Conrad Weiser homestead in the Memorial Park on the William Penn highway just west of Womelsdorf is a good illustration of the use of local limestone 200 years ago for substantial homes. This building has recently been repaired but the walls are original and show no deterioration of the limestone, which is weathered to a pleasing light gray. Other homes of a similar character would include the mansion at Charming Forge built by George Ege. The front of the mansion is coursed limestone ashlar, and the rest of the building is rubble. The ashlar is graded, with large blocks in the first story and thinner ones in the second story. Large retaining walls are of the same stone and all of this masonry is in good condition. The original lime mortar made with little sand is very hard. Barns and cottages erected for laborers at the furnace still stand and the latter are used as summer bungalows.

At Host is a large limestone house bearing a tablet marked "Christopher Leiss 1802" which is built of gray limestone rubble with black slate window key stones. This building and another large limestone house and barn, and the Washington Inn just north of there are all in good condition.

Another building of interest is the old Rieser mill one mile south of Leesport. This was built in 1825 of the local limestone rubble with corners of brownstone. The masonry is in good condition except the door sill which naturally is deeply worn.



Fig. 22. Ordovician limestone rubble and Triassic brownstone, Rieser mill (1825), 1 mile south of Leesport, Berks County.

Granite buildings. Granite rubble has been used in South Mountain for a number of buildings at Landis Store, Hill Church, and Gablesville. This rock is mostly granite gneiss, and field stones have been utilized rather than bed rock. In some areas, especially near Landis Store, the granite float is so abundant that it has been used for building pasture fences. Between Mt. Penn and Stony Creek Mills are several houses and many retaining walls of pink gneiss rubble derived from float on the mountain side. The dam at Antietam Reservoir also is of this granitic rock, but it probably came in part from a ledge at the end of the dam. Granite from the Walker quarries has been used in churches in a number of cities as listed in the description of Seisholtzville granite.

Seisholtzville Granite.

The Walker Granite Company is operating quarries at Seisholtzville, 3 miles south of Alburty. The quarries are reached by the Rittenhouse Gap Branch of the Reading Railway System, which has been extended from the Gap mines to the Walker property. This locality is in the South Mountain or Barrens of Berks County but is reached by fairly good highways. The dressing shop is half a mile west of Seisholtzville; one quarry is at the shop and others are half a mile south of the shop on the end of a mountain spur.

Although the principal rock of this region is gneiss in the vicinity of Seisholtzville, the gneiss is intruded by granite in such quantity

that the latter stone can be quarried. Every variation is to be found from clear granite, through granite with a few small inclusions of gneiss to gneiss with narrow intrusions of granite. The gneiss is predominantly reddish and its abundance or lack in any block partly determines the color or tone of that block. The granite may be described as coarse-grained gray rock with a pink tinge due to scattered pink feldspar. (See Plate II). Where granite is by far the lesser part of the rock the boundary of the gneiss is sharp, but where the granite predominates the boundaries of the included gneiss commonly are blurred as if the heat of the invading granite had partly melted or digested the fragments or blocks of gneiss which it surrounded. Many of the granite building blocks which have been produced here have decidedly pink or red blotches, which are seen on close examination to be lumps of partly digested gneiss. Rarely the granite contains lumps or segregations of almost pure hornblende. Some of the lumps are the size of a fist and perfectly black. Accumulations of pyrite may be found around the boundary of the hornblende segregations.

The quarry at the mill has not been worked recently and is partly flooded. A quarry half a mile south of the mill has been operated for several years. It is over 100 feet long, about 30 feet wide, and 10 to 25 feet deep. The rock is a gray granite with inclusions of pink gneiss. The rock close to the surface is in large lenses with well-rounded ends surrounded by soft sand, the result of disintegration along joint planes. At the bottom of the quarry the rock is more solid. Removal of the sand makes considerable dead work and the shells of the lenses also have to be discarded, only the centers being first class building stone.



Fig. 23. Granite quarry at Seisholtzville, Berks County.

As the sheeting of the granite in this quarry dips with the hill but steeper, the good live stone in the bottom is getting deeper and continued production means the removal of considerable overburden. Operation of this quarry has been discontinued.

In 1927 a new quarry was started near the top of the hill close by. Here the sheeting is arched and the granite is said to break with a loud sound when uncovered and loosened, suggesting that it is under strain. Some of the granite in this new quarry is spotted with black hornblende crystals up to an inch long; this feature is liked by some buyers and objectionable to others. In 1931 the new quarry measured about 75 by 150 feet and was 30 feet deep. The crane for lifting blocks out of the quarry is operated by a gasoline engine. Blocks are hauled from quarry to mill by automobile truck. Six to 10 men are employed and in that year most of the product was shipped to the Church of the New Jerusalem, at Bryn Athyn, Montgomery County.

The shop is a large wooden shed equipped with crane, storage yard, and railroad spur. All dressing is done by hand. Adjoining the shop is a crushing plant. Here the spalls and sap-rock are broken in a gyratory crusher, screened for ballast, re-crushed and screened for road metal, chicken grit, and building sand.

Granite from the Walker quarries was used in the following buildings: St. Ursula Church, Bethlehem, 1923; Bethlehem Lutheran Church, Reading; Reformed Church, Easton, 1923; Catholic Church, Bangor, 1923; Asbury M. E. Church, Bethlehem; Emmanuel Reformed Church, Bethlehem; Lutheran Church parsonage, 13th and



Fig. 24. St. Johns Lutheran Church, Emaus, Lehigh County. Built of granite from Seisholtzville, Berks County.

Hamilton Streets, Allentown; Zion Lutheran Church, Sunbury; Christ Lutheran Church, 13th and Market Streets, Harrisburg. Three other churches of Seisholtzville granite have been built in Bethlehem, St. John's Reformed Church (1922) and St. John's Evangelical Lutheran Church (1923) in Emaus, one in Trexlertown, besides residences and office buildings. Some of the coping stones in St. Ursula Church and school at 12th and Broadway, Bethlehem, measure 8 by 15 inches by 7½ feet. The Reading Railway stations at Wernersville, Reading, and Pottstown are of this granite. Accompanying illustrations show the use of this stone.

Webster Gery and Michael Beck of Spring City, Chester County, opened a small granite quarry about a quarter of a mile south of the Walker Granite Company shop near Seisholtzville in 1922, equipped it with derricks, and got out about two carloads of stone roughly shaped for building. None was shipped, however, and the property has been idle since that year. In this quarry one face shows schistose bands 4 to 5 feet long surrounded by granite, and in another part of the quarry the younger granite is merely a network of small stringers in the gneiss.

BLAIR COUNTY.

Lying east of the Allegheny Front, Blair County is geologically unlike Cambria County which borders it on the west, but very like Huntingdon County on the east. That Blair County is within the Vallemont region is very apparent on a topographic map, and the northeast trend of the rock formations is seen on a geologic map.

The population is largely in the limestone valleys and more than half the people in the county live in Altoona and Tyrone.

Rocks in this county range through the geologic column from the Trenton limestone to the base of the Coal Measures. The oldest of



Fig. 25. Ordovician (Beekmantown) limestone quarries near Tyrone, Blair County.

these rocks, the Trenton limestone, underlies the broad valley of Clover Creek in the eastern part of the county between Tussey, Loop and Dunning Mountains, and Sinking Valley in Tyrone Township. Medina-Oneida sandstone, the great ridge maker in the central part of the State, is well developed in this region and occurs throughout the length of Brush Mountain on both sides of Sinking Valley, Loch, Loop and Dunning Mountains, and in Tussey Mountain along the east boundary.

The Helderberg limestone crops out in a direct line from the northern border of the county along Little Bald Eagle Creek, through the eastern edge of Altoona to beyond Hollidaysburg, makes a loop around Frankstown Township, and then follows the west flank of Dunning Mountain south. The Oriskany sandstone is along the west edge of this limestone, except in the Frankstown loop, where it is on the inside edge. The low east slope of Allegheny Mountain from Tyrone to Claysburg is underlain by Devonian sandstone and shale, and the steep upper slope by Pocono sandstone. The Pottsville conglomerate is along the top of Allegheny Mountain.

These sandstones and the two limestones are the main source of building stone within the county. Limestone is quarried extensively at Ganister west of Williamsburg, and in a quarry a mile long near Tyrone but mostly for flux and not for building stone, though it could be used for that purpose. The only building stone quarries that I found operating in 1929 are on the end of Brush Mountain east of Lakemont and 3 miles north of Hollidaysburg where Stormer & Son, Wm. Burke, and J. S. Heverly, all of Altoona are quarrying a hard sandstone of Medina or Clinton age.



Fig. 26. Medina sandstone, Stormer & Son quarry, Brush Mountain, east of Lakemont, near Altoona, Blair County.

The Stormer quarry, worked for 18 to 20 years mostly for foundation rubble, is well up on the mountain but reached by a fair road. It is about 250 yards long and 50 yards wide, on beds dipping W.

10° nearly parallel with the slope. The excavation is about 30 feet deep at the upper end and 15 feet at the lower end. Quarrying is with pick and bar because joints are so close that these tools suffice. The thickest stone is about one foot, which is ample for ordinary ashlar. The joint faces are brown to black, but fresh broken faces are gray, speckled, and some slightly streaked with red. This stone is like ganister and should be very durable.

Wm. Burke has two quarries, one adjoining Stormer's and another in the same formation at the foot of the mountain near Lakemont. Stone in the lower quarry is more irregularly jointed, and the overburden is heavier, but the haul down the mountain is avoided.

This quartzite or ganister from the quarries near Lakemont has been used for foundations at Lakemont and Fairview, for the basement of the Catholic Church on Juniata Road near Fairview, and Temple Lutheran Church, 6th Avenue and 22d Street, Altoona. By special selection an all white stone can be had, as a house at Sylvan Mills. The Kahn and McVey houses at Allegheny Furnace are of this stone. An old quarry at Allegheny Furnace is in Helderberg limestone.

Rubble for foundations in Altoona has come in part from Medina float on Brush Mountain in Kettle Creek Gap. Loose blocks of quartzite or hard sandstone were abundant and readily accessible right along the road through the gap and are still a hundred yards or so back from the road. This loose material along the steep mountain flank has been used also at Tyrone and other places for rubble and has been crushed for concrete.

Stone Buildings.

Altoona. One difficulty about the older stone buildings in Altoona is that, unless they have been cleaned, they are black with coal soot. This makes identification of a stone or its probable source increasingly difficult. Some stone buildings are very black; on others the soot has accumulated on the upper surfaces of blocks with high relief and dribbled down over the lower side. The accumulation of soot on buildings of the same kind of stone, in rock-face ashlar, is illustrated by three churches on 6th and 8th Avenues, all apparently quartzite from Brush Mountain. Temple Lutheran Church (1928) at 6th Avenue and 22d Street is clean, a light gray; but the Eighth Avenue M. E. Church (1901) and the First United Brethren Church (1898) are black. St. Luke's Episcopal Church (1881) at 8th Avenue and 13th Street is blackest because older than its neighbors. Its surface stone is Berea, Ohio, sandstone, and the dressed blocks are Amherst, Ohio, sandstone. Another building thought to be of Medina sandstone from Brush Mountain, but now badly stained is the First Presbyterian Church (1898). The First Evangelical Lutheran Church (1896), built of sandstone which is now stained black, appears to be Ohio sandstone, except the new wing, which is Pocono or Pottsville sandstone from that part of Allegheny Mountain west of Altoona known as Buckhorn Mountain.

Brownstone, probably from Hummelstown, was used in the First M. E. Church (1905), W. F. Gable Co. store, Rothert Co. store, Mountain City Trust Co., Simpson M. E. Church (1904), Christ

Reformed Church (1902), Roman Catholic Church (1923) on Eighth Avenue. These buildings are soiled with soft coal soot and slight scaling of the brownstone was observed in the First M. E. Church.

The City Hall, first story, is Indiana limestone on a granite base; first story of Penn Alto Hotel and the facing of the Roman Catholic Cathedral (1928-1930) are Indiana limestone. Pink granite from Salisbury, North Carolina, is the principal stone in single houses at Juniata Gap, Allegheny Furnace, 23d Avenue and 11th Street, Fairview; last house on 14th Street, 215 Lloyd Street, and at Eldorado.

Tyrone. Being at a gap in Brush Mountain, Tyrone is adjacent to steep slopes covered with rock floe from the Medina sandstone. This material is gray and red hard sandstone and has been utilized for rubble foundations, for the National Guard Armory (1912) and laboratory of the Wilson Chemical Company opposite the railroad station. These buildings in gray and red rubble evidence the suitability of the local mountain floe rock for construction. Other stone buildings or fronts in Tyrone are the Methodist Episcopal Church (1927) of Mount Airy, N. C., granite; Presbyterian Church (1927) and First National Bank, Indiana limestone; Blair County Bank & Trust Company, and English Lutheran Church (1904) of brownstone.

Hollidaysburg. The Court House, built in 1877, was described in 1880 as follows:¹

"The exterior walls are of stone-facing, cut stone. The color of the main body of the work is warm, rich, sunny buff-arch stones, string courses, cornices and other ornamental portions of the rock, are of a beautiful deep, peach bloom color, presenting a strong yet agreeable contrast."

BRADFORD COUNTY.

Bradford County lies along the New York State line between Tioga and Susquehanna counties. The North Branch of the Susquehanna crosses it and is followed by the Lehigh Valley Railroad. The Pennsylvania Railroad crosses the western end of the county. A large part of the county is underlain by the sandstones and shales of the Catskill and Chemung formations. Two structural basins in the southwestern part of the county contain the Pocono sandstone, Mauch Chunk red beds, and Pottsville conglomerate.

Bradford is a big county, thinly settled and has comparatively few stone buildings. These are mostly in Towanda and Sayre. Small quarries have been opened in various places but the only ones I heard of that were operating in 1929 are southeast of Towanda and near LeRaysville.

At Towanda, the county seat, there are only four conspicuous stone buildings. These are the court house, jail, an office building, and church. The court house (1896) is of massive conglomerate and sandstone quarried a few miles south at Weston and is probably either Pocono or Pottsville age. In some of the blocks quartz pebbles of the size of peas are very abundant. The front of the building is smooth dressed, coursed ashlar and the sides are rock-faced, dark gray, and dirty. The smooth front is very light colored and under the portico

¹ Ewing, Jos. H. and Slep, Harry. History of City of Altoona and Blair County, pp. 26-27, Altoona, 1880.



Fig. 27. Pocono sandstone from Weston, in Court House, Towanda, Bradford County.

where it has been protected from the weather is almost white. Blocks are up to 4 feet long and 16 inches thick. No evidence of deterioration was apparent except here and there a little development of iron stain.

The jail (1871) likewise is of massive sandstone laid in rock-faced, coursed ashlar. The blocks vary in size up to 5 feet long and 2 feet thick. The building now has a rusty to pink tinge especially around the recessed front door where the stone is protected from staining. The tone must have been pleasing when the building was new. Inquiries fail to disclose the source of this stone, but presumably it is from the nearby Pocono.

The Ontario Block, in which is the office of the *Daily Review*, is of sandstone and conglomerate from the same source as the court house. Christ Church (Episcopal) also of white pebble conglomerate and sandstone laid in rock-faced, coursed ashlar is the same material and must have been very light colored when the building was new. The blocks are 2 to 8 feet long and up to 1 foot thick.

In Sayre, the only stone buildings noticed are the Episcopal Church (1888) which is rock-faced, random ashlar, grit or conglomerate like the court house in Towanda. The stone is all in good condition. The Episcopal Parish House (1908) is a green, fine-grained sandstone in rock-faced, random ashlar, the source of which was not learned. The general effect in the wall is a slightly tan to gray color.

Perhaps the most extensive quarrying at any one locality in Bradford County was that done near Hornbrook many years ago. This place is 2 miles north of Towanda on the east bank of Susquehanna River and $\frac{1}{4}$ mile up a brook. Here there were at least three separate operations. The first is the Towner quarry on the W. S. Elsbree farm on the east bank where the road has been completely washed out. The quarry face is 200 feet long and was worked back on a 10-foot bed with a middle parting, to where the top shale and slabby sand-

stone is 20 to 25 feet thick. In places the overburden overhangs the last quarrying operations. Flags, curb and stock were produced here which weathered to dark greenish-gray.

Next above is the MacAfee mill and quarry. The main quarry is about 100 feet long on a massive-bedded gray sandstone about 6 feet thick under 15 to 25 feet of shelly wavy waste. The face has been worked back to a point where the recovery of any more stone would be impossible without removing much overburden, except for a small quantity that could be raised at the upper corner of the quarry. The wreck of a mill, originally equipped with stone saws and planer stands on the quarry floor. The road along the brook just below this mill is all washed out so that the place is no longer accessible by wagon.

Along the creek above the MacAfee quarry is a vertical cliff exposing about 10 feet of massive sandstone, under 15 feet or more of worthless sandstone. This cliff is the result of quarrying and extends up the brook at least 100 yards to the place where the ledge is exposed in the bed of the brook. This upper end is known as the Franklin quarry and was the source of curbing which was raised in the brook bed where about 8 feet of gray massive sandstone with a 2-inch and a 6-inch slate partings are exposed.

A small opening on a sandstone bed in the hill just about the Elsbree house may possibly be on the same ledge. No quarrying has been done at any of the above mentioned places in several years.

The only active quarrying operations in Bradford County in 1929 so far as I discovered are near LeRaysville and in the valley of the Susquehanna below Wysox.

1927 the LeRaysville Stone Company (office at Nicholson) opened a quarry about 4 miles south of LeRaysville along the main highway. In June 1929 the face was about 150 feet long on two



Fig. 28. Flagstone quarry of LeRaysville Stone Company 4 miles south of LeRaysville, Bradford County.

sandstone ledges 6 feet and 4 feet thick, with a thin slate parting. The overburden of shaly sandstone ranges from 6 to 20 feet. The thicker ledge makes flags, and the 4-foot bed makes stock. The flags are 2 to 3 inches thick and can be made in any size desired. Eight men were employed under Lou Van Ness, boss quarryman. The principal difficulty with the location is that the waste must be dumped on the other side of the highway. One electric crane, one gasoline crane, and an electric compressor for the jackhammer are used at this quarry. The stone ranges from blue to gray in color.

Near the State highway south of Durrell, a large bluestone quarry that was operated many years ago was being worked in 1929 by

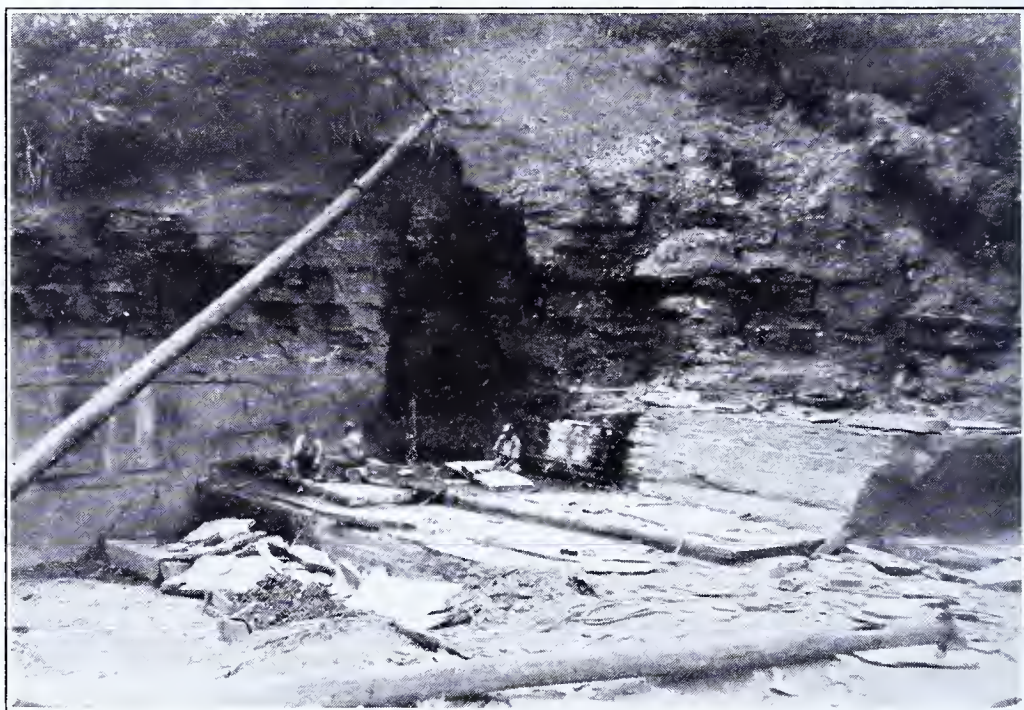


Fig. 29. Flagstone quarry worked by Frank Holdren at Durrell, Bradford County. Note overburden, even bedding and method of working.

Holdren and Woodruff. Frank Holdren of Laceyville operating at the east end of this big quarry has a ledge of bluestone about 12 feet thick, with a thin slate parting near the middle. The upper part lifts in 2-to 5-inch flags, and the lower part runs heavier. The flags split generally with a very smooth face. The main joints are vertical and very straight, and so aid in the working of this quarry. A gasoline motor operates the winch on a large derriek and also compresses the air for the jackhammer. Flags of any desired size can be made, and the heavy stock will work into curb. Four men are employed. The output is delivered by truck mostly to Ridgway's yard at Laceyville. This is the quarry formerly worked by Kelley and Keiser of Towanda, and by Jerry Vandernart.

J. L. Woodruff has a lease on the west end of the same quarry 100 yards from where Holdren is working. This quarry has the same kind of power equipment and also employs four men. The present output is all bluestone flags up to 4 inches thick. The heavy stock

is not shipped at present for lack of demand. The ledge is about 7 feet thick under a cover up to 15 feet thick. This cover is easily removed by drilling and shooting off into the quarry whence it is moved by a box on the derrick. Some of this waste is very hard but it breaks so irregularly as to be valueless. In June 1929 men were setting up a derrick preparatory to opening a new quarry 100 feet west of Woodruff's location.

On the Clark Johnson farm, in the creek bank a short distance south of these last mentioned quarries, an old flag quarry has recently been reopened and is yielding green and blue flags up to 10 feet long. Some of the surfaces are wavy and these layers are not mark-etable. The ledge is 6 to 8 feet thick with little overburden and the flags are mostly 1 to 2 inches thick. A crane boom lashed to a tree is used for moving the flags across the creek. High on the hill above the house on this same farm there is another small flag quarry not at present in operation.

Farther south on Mrs. Margaret Johnson's farm a small flag quarry has recently been opened at the road side where there is practically no overburden, and where good gray flags may be obtained. The quarry was reported to be idle because there was no place for the rubbish. Other quarries have been opened in this vicinity but have not been worked for 20 or 30 years. On Viall Hill $1\frac{1}{2}$ miles from Terrytown, and 5 miles from Wyalusing, production of bluestone has been resumed at an old locality on the Furman Johnson farm by J. Johnson and Daniel Pond who are getting out flags for Ridgway at Meshoppen. Their production ranges from 1 to 6 inches thick and includes curbing. In June, 1929, they shipped one stone that measured 10 feet by 5 feet by 4 inches. They have little overburden on their gray sandstone ledge which is about 10 feet thick. This quarry is only one point on the ledge which has been developed for at least 40 rods along the outcrop. These old workings, however, are now concealed by young trees.

The only other quarry recently operated in Bradford County is on Sugar Run 3 miles from Wyalusing. This new quarry is one mile up Sugar Run on the east bank, and was operated by Russ Rosencrans. It shows 6 feet of massive bluestone under 15 feet of unconsolidated sand. The product is heavy stock suitable for curbing; at least the blocks around the quarry which are from 8 inches to 2 feet thick suggest this, rather than flagging. Blocks 5 to 6 feet square and 8 to 10 inches thick have been lifted. The color is gray blue. An old opening 100 feet away shows the same ledge at least 10 feet thick. A flag quarry high in the hill opposite Rosencran's house has been idle many years.

I saw no stone work at Wyalusing and Wysox worthy of mention, except the fine flag walks in front of the stores.

BUCKS COUNTY.

Bucks County was one of the three original counties of the province in 1682 which together with Philadelphia and Chester Counties, extended from the Delaware to the Ohio.

Next north of Philadelphia and Montgomery counties and bordering Delaware River from Bristol and Trenton to Durham Furnace is Bucks County, said to be named from Buckinghamshire, England.

This county extends from South Mountain across the Triassic belt to the Chickies quartzite and Wissahickon gneiss on the southeast. Triassic red shales and sandstone underlie about 80 per cent of the county. The quarries in these beds are described in the following pages, followed by a description of the quarries in the diabase, black granite, or trap which is intruded in these sediments. Diabase is most abundant in the vicinity of Quakertown which is completely surrounded by it at a distance of one to four miles. In the northern end of the county near Springtown the higher hills are gneiss and some of the valley is underlain by Cambrian limestone and Hardyston quartzite. Quartzite occurs also in Buckingham Mountain and Cambrian limestone extends from Bushington northeast to the Delaware above New Hope. The dark blue limestone $1\frac{1}{2}$ miles north of New Hope is so closely jointed that it is not suitable for building stone. It has been burned for lime and pulverized for agriculture. I did not observe that the Hellam quartzite has been used for building purposes.

The Wissahickon gneiss probably underlies the eastern end of the county east of the Reading Railroad but it is so buried under clay and gravel deposits that it is rarely exposed.

Sandstone and Quartzite.

Langhorne. Several buildings in Langhorne are constructed of micaceous quartzite from the quarry of Jos. H. Lennington. The People's National Bank Building is an example of this stone. To the writer this stone seemed to closely resemble that quarried by the Foxcroft Stone Company at Broomall, Delaware County. The quarry is west of Langhorne Manor in the woods below the waterworks stand-pipe, in the Chickies (Edge Hill) formation. The strike of the beds is northeast and the dip nearly vertical, even turned over at the surface. The quarry driven into a creek bank has a face 15-25 feet high, and is worked only intermittently by one man. The product is blocks mostly not over five inches thick of blue-gray quartzite with glistening sericite bedding planes and occasional blue quartz pebbles. Thin sections of this stone under a petrographic microscope show that the rock consists of primary quartz and sericite with some bluish-black tourmaline and no feldspar. Some slabs $1\frac{1}{2}$ to 2 inches thick suitable for small flagstones are also produced. The stone from this quarry in a schoolhouse near by and in the bank at Langhorne is weathered much darker than the freshly quarried stone.

The St. James' Episcopal Church and the Town Hall at Langhorne, which contains the post office and fire house, are built of a pinkish conglomerate from near the base of the Stockton formation of Triassic age. The lower courses are of hand-dressed rectangular blocks and show clearly the conglomeratic character. This stone was quarried at the E. M. & Luther Ridge quarry on the south bank of Neshaminy Creek just above the mouth of Core Creek at Bridgetown. The beds strike N.70°E. and dip N.12° toward the creek so the quarried rocks move easily. This is a one-man intermittent operation. The upper layers in the quarry are thin and soft, but at a depth of 12 feet the rock is hard conglomerate. Some beds are sparingly, some heavily charged with rounded quartz and quartzite pebbles up to an inch or more in diameter. The sandy beds are coarse-grained and arkosic, and in some places carry abundant and large flakes of white mica.

It is interesting to note that on the four corners of the main cross

roads in Langhorne, the Langhorne Hotel, a thick walled stone building owned by George C. Ehrlen, was built in 1724, the opposite corner in 1738, the house across the way in 1763, and the brick building on the northeast corner in 1802.

Neshaminy Falls. On the east bank of Neshaminy Creek opposite the amusement park and half a mile from Janney Station on the Reading Railway System is a large quarry in Baltimore gneiss and on the south side of it a small quarry in Chickies (Edge Hill) rocks. Both these quarries are operated by Charles T. Eastburn of Yardley. The thin, vertical beds are a very light colored sericitic quartz schist which has good rectangular fracture and easily breaks in square-faced thin building stone. The second quarry is described under Gneiss.

Newtown. Many houses in this old town are built of the local Triassic brownstone, probably from the upper part of the Stockton formation. The First National bank was a good example of the work that could be done with it but has since been torn down and rebuilt in brick and Indiana limestone. This quarry in its prosperous days furnished many of the brownstone fronts in the residential sections of Philadelphia and New York. The only quarry worked recently, and which has furnished much stone for local use, is $1\frac{1}{2}$ miles west of the town on the bank of Neshaminy Creek. It was opened at least 50 years ago and was known for many years as the Mitchell quarry. When visited in September 1927 the quarry was in active operation by C. T. Eastburn of Yardley, employing three men getting out building stone. The quarry was originally opened in brownstone but as the beds pitch into the hill at an angle of 10° , advance has been into successively higher beds and the quarry now is in massive gray sandstone, overlain by thin-bedded brown sandstone of no value. The massive gray stone breaks out in large blocks. One just loosened when I was there measured 8 by 4 by 3 feet. These blocks are split to 3-foot cubes, lifted out by a derrick and horse whim and split to ashlar. Some stone in this quarry is soft and sugary but the quarry product is a dense, hard and pleasing building stone. Two systems of vertical joints nearly at right angles to each other, and with smooth faces 4 to 20 feet apart facilitate quarrying. Brownstone from this quarry besides being used in Newtown in the First National bank, remodeled in 1929 in brick and Indiana limestone, Methodist and Presbyterian churches, Friends Home, Mitchell house, basement walls of the George School, and private houses, went into the construction of the Catholic Episcopate and the German Hospital, Philadelphia; Convent of the Good Shepard and Episcopal Hospital, Germantown. The Catholic Episcopate in Philadelphia is considered by former operators of the Newtown quarry to be one of the handsomest buildings ever constructed of this once well-known stone.

Doylestown. Some houses and many boundary and retaining walls are built of light tan, pale purplish, red and blue sandstone of local origin. It is said that in the old days each farm produced the stone for its own buildings, but now if one wishes to build a house of native stone at Doylestown, he buys an old stone building or stone wall, for no quarry is operating near by.

The Fountain Inn (1748) at Doylestown, in which all furnishings are antique, even to the chambermaid's brass scrub bucket, is built of local sandstone.

East of Doylestown at Spring Valley an outcrop of deeply weathered Triassic conglomerate is worked for sand and gravel. Between Doylestown and Buckingham (formerly Centerville) houses, barns, and walls of sandstone are common. The stone is brown, drab, gray, and tan, fine to coarse grained, and some has quartz pebbles.

The Court House at Doylestown is built of sandstone from Yardley, Pa. and Stockton, N. J. and trimmed with brown sandstone from Newtown; the lintel over the entrance to the court room is an exceptionally large block.

At Dyerstown, $2\frac{1}{2}$ miles north of Doylestown, is a grist mill built by John Dyer in 1714 and now used as an antique shop and tea room. The upper story is not so old as the lower story. The walls are of brown, gray, and tan sandstone probably quarried close at hand. The front and ends of the mill are plastered but the rear is not, and here the stone can be seen to be in good condition, even those in the race which have been subjected to the rush and dampness of the race water for two centuries.

Yardley. Two miles north of Yardley on the bank of the canal is a quarry in Triassic sandstone operated formerly for crushed stone but now for building stone. C. T. Eastburn of Yardley operates this quarry, getting out brown, reddish, and blue rough stone. It is known as the Mt. Eyre quarry. The joints are so nearly vertical to the bedding that rectangular blocks are easily made. The beds strike NE. and dip N. 10° . The quarry face is 175 feet long and up to 40 feet high, in fine-grained ringed sandstone. With the assortment of colors available here in very durable stone it would be possible for a builder to work out pleasing effects, either by random mixing of the colors in a wall, or by the use of one color in the wall and another for trim.

The Old Ferry Tavern at Washington Crossing (Taylorsville) 4 miles north of Yardley is built of Triassic sandstone, probably from surface workings in the nearby hills. The wing facing the river was built in 1757 and is older than other wings. All stone in the tavern appears to be in good condition.

Lumberville. At the mouth of a small ravine on Delaware River one mile east of Lumberville a hardy pioneer 170 years ago (1758) built a home and a mill. He quarried the stone for the walls from the ledge near by, and thus started an industry that has continued on this site to the present day. This home with additions became The Hard Time Inn of Colonial days. Somewhat remodeled and the stone work pointed up, it has become an artist's home. The red and gray sandstone blocks in the walls are in good condition after all these years.

Here unusually hard sandstone strikes northeast and dips NW. $10-13^{\circ}$. It is of Triassic age and probably in the Stockton formation, named from the New Jersey town two miles below. It is not the typical brownstone, but is rather red and gray quartzitic sandstone. At the surface the rock is closely jointed and insipient bedding has developed at intervals of a few inches, but at depth the joints are few and the rock so massive that large blocks suitable for heavy bridge masonry can be taken.

Two quarries west of the ravine and along the canal bank have long been abandoned. One is said to extend 60 feet below road level, but is now full of water. These two are separated by a wall 30 to 40 feet thick of stone not fit to quarry. The rock varies considerably in

texture, fine-grained stone being interspersed with conglomerate. The Lumberville Granite Company worked these quarries and called the stone granite because it is so hard. For years this quarry supplied Philadelphia with many barge loads of paving blocks, besides rough and dressed building blocks and rubble.

Just east of the ravine is a large quarry formerly known as the Paxson quarry and now operated at times by C. T. Eastburn, of Yardley. It is directly on the highway and canal bank, and formerly shipped much building stone. The beds here are stratigraphically below those in the quarries just mentioned, but like them the stone is not uniform. Most of the stone is fine-grained and of good quality but it is interspersed with streaks of shale and conglomerate. The latter is not definitely separated from the fine-grained massive sandstone by bedding planes but occurs as thin or more or less definite bands in the midst of the massive sandstone. The pebbles are mostly less than two inches in diameter and are quartz and brown shale. A vertical face 400 feet long and up to 80 feet high has been developed.

Near the outcrop the stone is in thin layers, owing to weathering effects, but at depth it is heavy bedded to massive. The joints are at right angles and very few, in places 20 feet apart, so that stone of any desired size up to the limit of a crane or truck's capacity are procurable. The common color of the stone is bluish gray, with less light brown to red. By sorting from a large stock, orders for stone of uniform color can be filled. The hardness is superior to that of ordinary brownstone. Although this stone is hard to drill, it splits remarkably straight. West College, Princeton University, is faced with stone from this quarry.

Three or four other quarries east of here are in similar stone but have long been idle and are of no present interest.

Carversville. Two miles southwest from Lumberville and so away from shipping facilities a quarry was opened at Carversville about 50 years ago. It was operated from 1881 to 1885 to get light colored stone for various schoolhouses and churches but difficulties about stripping and drainage, as well as distance from the canal seem to have deterred extensive working. The opening which I saw in 1924 had a face about 150 feet long and 20 feet high in horizontal bedded gray and greenish sandstone. This is on the creek bank by the bridge just below the little hamlet. Recent use of this quarry has been as a source of crushed stone for township roads.

Perkasie. On top of the ridge north and west of Perkasie are three quarries operated by C. G. Schwenk, E. G. Hoyler, and Perkasie Borough for crushed stone. The stone is very fine grained shale and sandstone that may have been altered by heat from the intrusion of diabase or trap. The result is a hard, blue to black rock suitable for roads and concrete. Joints are vertical and bedding is horizontal. In the lower part of the quarries or 20 feet below the surface the rock is massive. Building blocks could be made here if there were a demand for this black stone.

Telford. One mile north of Telford, which is on the county line, blue-black hard shale is quarried by E. E. Derstine, Souderton, for crushed stone. The quarry is about 175 feet square and 30 to 40 feet deep. It has two bands of black shale, and some red sandstone but is mostly in fine-grained hard bluestone. The joints are at a right angle

to the bedding and spaced from a few inches to several feet apart. Bedding has a gentle northwest dip. Some beds in this quarry yield reetangular blocks; others are massive and break any way. Grace Evangelical church, corner of County Line and Reliance Road, Telford, was built of stone from this quarry in 1925. Although the work is rough-faced random ashlar and the stone is bluish-black, the otherwise somber effect is very largely relieved by narrow white pointing and by white stone trim (in this case cast stone). A few blocks 6 to 8 inches thick break the monotony of the slabs.

Pipersville. In the northeastern part of the county, as at Fern-dale and Kintersville, the common building stone is Triassic sandstone which may be brown or blue-gray. At Pipersville however, the stone used in two new houses is black hornfels like that quarried at Perkasio and Telford. Most of the large blocks are rectangular, and the size ranges up to 5 by 10 by 18 inches. In one house the block faces are all fresh and black, with narrow, white pointing; in the other many iron-stained joint faces are exposed and the pointing is less conspicuous.

Point Pleasant. About one mile southwest of Point Pleasant on the south bank of Geddes Run, Mr. A. H. Fell of Danborough is quarrying hard Triassic shale or argillite and crushing it for road metal and concrete aggregate. The rock is very fine grained, dense, and black. Building stone for rough construction and riprap can be produced. Its color is too dark for an attractive building stone. A highway passes the edge of the quarry and the Delaware canal is only one mile away.

The quarry is 125 feet long and 33 feet deep. Equipment consists of a steam engine, Beaumont Manufacturing Co. 10 by 20 inch jaw crusher, cylindrical screen, and wooden storage bin. The output is crushed stone only, sold mostly for road metal.

Gneiss.

At Neshaminy Falls half a mile from Janney Station on the Reading Railway System, C. T. Eastburn of Yardley operates a quarry in Baltimore gneiss. This stone breaks out in long slabs several inches thick and has a considerable range of color. Stone of this character and presumably from here or some ledge near by was used in 1789 to build the Meeting House at Langhorne and the Meeting House at Fallsington, Bucks County. The churches more than 140 years old, are evidence of the durability of this stone and show how it may be expected to appear after long exposure.

Stone from the Neshaminy quarry has been used recently for facing the following buildings: Walker and Hayes residences, Yardley, Bucks County.

Shriner's Hospital for Crippled Children, Roosevelt Boulevard, Philadelphia.

Donison and J. D. Herring residences, Princeton, N. J.

Grace Baptist Church, Trenton, N. J.

Grace Presbyterian Church, Montclair, N. J.

St. Matthew's Episcopal Church, Woodhaven, Long Island, N. Y.

Harry F. Knight residence, St. Louis County, Missouri.

Diabase.

In northern Bucks County a coarse-grained diabase is quarried in several places north of Quakertown for monuments and at Rock Hill 3 miles southeast of Quakertown the General Crushed Stone Company is quarrying and shipping crushed diabase or trap at the rate of about 3,000 tons a day. The quarries of interest in this report are those that produce monument stock.

Coopersburg Granite Co. Two miles east of Coopersburg on the south side of a rocky hill, a quarry was opened and operated by E. W. Bradford in 1920-21. It was bought in January, 1923 by the Coopersburg Granite Co., which has continued to operate it. This company built a mill at Coopersburg, just over the line in Lehigh County, and began dressing stone June 1, 1923. Victor Riu is manager of the company.

The quarry in October 1927 had a face 100 feet long and up to 50 feet high. Drills are operated by compressed air and the quarry blocks are handled by two derrieks. Twelve men are employed at the quarry. In 1924 a one-story stone building, 24 by 54 feet, was erected



Fig. 30. Diabase quarry of Coopersburg Granite Company in northern Bucks County. Photo furnished by the company.

at the quarry to house machines for rough dressing the blocks before moving them to the shop on the railroad at Coopersburg. Electric power is used to operate a stone saw and a 20-ton derrieck.

The stone is a true diabase, has a blue shade on fresh fracture, and takes a high polish. The polished surface is black but letters and designs cut in it are gray. The predominant minerals in the rock are plagioclase feldspar and augite. A thin section of the rock examined under a petrographic microscope shows that the feldspars are lath-shaped crystals and the augite fills the spaces between them. This texture is typical of diabase and makes a very strong rock.

Analysis of diabase from quarry of Coopersburg Granite Co.¹

	Per cent
SiO ₂	51.67
Al ₂ O ₃	15.18
Fe ₂ O ₃	12.60
CaO	11.36
MgO	9.39
K ₂ O, Na ₂ O	0.50
Ignition	0.20

Although most of the rock quarried has a fine granitic texture in which the individual grains can be seen by the naked eye, this quarry also yields a stone of such fine texture that the polished surface is described as velvet black.

The rock resists weathering well and even loose blocks on the surface can be broken up for building stone. Very little if any alteration can be seen between the rock at the surface and that at the bottom of the quarry. In fact some spheroidal weathered blocks just below the surface, when broken, show no evidence of weathering deeper than a small fraction of an inch.

The output from this quarry is hauled by truck to Coopersburg and



Fig. 31. Diabase monument, Richlandtown, Bucks County. Shows contrast of carved and polished surfaces.

made into monument stock. The dressing shop employs 12 men and ships monuments with polished and ornamented faces ready for lettering. Many examples of this stone are seen in local cemeteries. The accompanying photograph of a polished diabase monument was made in the cemetery at Richlandtown. This company made the pedestal of the Shakespeare monument near Logan Circle in front of the Free Public Library, Philadelphia. Bronze figures of Shakespearean

¹ Analysis from report made to Coopersburg Granite Company by J. S. Long, Lehigh University.

characters surmount the highly polished black diabase, in which are carved the names of eminent Philadelphia actors.



Fig. 32. Diabase from Bucks County in Shakespeare memorial, Logan Circle, Philadelphia. "Black granite" quarried and finished by Coopersburg Granite Company.

E. W. Bradford & Son. In November 1924 E. W. Bradford & Son of Coopersburg were developing a quarry 200 yards east of the quarry of the Coopersburg Granite Co. The quarry when visited measured about 20 by 30 feet and was 15 feet deep. Big blocks of diabase resting on the surface were also being broken up for shipment. The largest blocks ready for shipment were 18 by 30 by 72 inches and a 3-foot cube. The stock is suitable for monuments and building. In 1931 the quarry was very much larger, equipped with power for operating the crane, etc., and was shipping rough blocks to Boston, Mass. for monument stock.

Black Diamond Granite Corporation. This corporation, formerly the Pennsylvania Black Granite Co., has an office in Quakertown, and three quarries on the Bethlehem Branch of the Philadelphia & Reading Railroad at California $2\frac{1}{2}$ miles northwest of Quakertown. One quarry and the shop are directly on the railroad, a smaller quarry and shop are on the creek a few rods away, and the other quarry is on top of a hill $\frac{1}{4}$ mile west. Most of the product from these quarries was used for monuments, but the stone is equally good for building and paving blocks. Stone from the hill quarry is darker, tougher, and

harder to work than that at the quarries on the railroad; it takes a fine polish. The larger quarry on the railroad is 100 feet long and 30 feet deep. When visited in November 1924, a cube of diabase measuring about 25 feet between joints was being broken out. This slightly lighter colored stone works well for building stone.

Electric power operates two rough-dressing machines, one polishing machine, derrick, and compressed air hand drills.

Operations began here about 1915, according to M. Ceechi, treasurer of the corporation, and in charge of the field operations. About 1925 the company abandoned quarrying at California because white veins in the rock then being quarried made the product unsalable. They leased the Bradford quarry mentioned above. In October 1927 when last visited by the writer this company was quarrying and rough dressing blocks at the former Bradford quarry and trucking them to the shop at California for finishing. The quarry still is small but it yields good sound stone and large blocks can be raised. A gasoline engine makes compressed air for operating drills, derrick, and dressing machine.

Wenz Co., Inc. About 20 years ago a quarry was opened in the diabase $\frac{1}{2}$ mile southeast of Shelly, and then lay idle for 15 years. It was worked for a few months and again lay idle. In March 1921 the Wenz Company began operations at this place and in November 1924, although business was dull, was employing 15 men. The plant was operated by steam power and equipped with a big derrick, air compressor, rough dressing machine, and polishing machine. The product is mostly monument stock, which was shipped to the Allentown yard of the company for cutting design and letters. Stone from this quarry was used for facing the Liberty Trust Co. building on Hamilton Street, Allentown, in 1922, and the office building at 1133 Hamilton Street, for the Harry L. Ritter monument, Easton, and the Ellen Goetz monument, Nazareth. Belgian blocks to be used for sewer lining in Philadelphia were being shipped in November 1924. This quarry is no longer operated.

Wm. Polambo. In 1924 Wm. Polambo was opening a diabase quarry less than one mile south of Shelly and was building a brick dressing shop and office at Shelly. In November the quarry was an oval about 30 by 50 feet and 25 feet deep, in fine blue rock. Eight men were employed at the quarry. The derrick and air compressor for the drills were operated by gasoline engine. Practically no rock had been shipped. It was proposed to make monuments only, and it was expected that the shop would be in operation early in 1925. When visited in the fall of 1931 the writer found this quarry idle and apparently no further developed than in 1924.

Quakertown. Several houses, stores, and a theatre in Quakertown are built of the local "black granite" or diabase. The rock dresses well into square-cornered blocks and is very durable but is unattractive for the main walls of buildings because it is so dark and somber. The Reading Railway station is a good example of the local stone. In this town one may see the architectural effect of rectangular blocks about 10 by 15 inches laid with broad gray or narrow white mortar joints, contrasted with walls of rough angular blocks.

Richlandtown. Crushed diabase for roads and concrete was for-

merly produced by L. M. Weavers Sons $\frac{3}{4}$ mile north of the village. The stone has been quarried locally also for building purposes as is shown by the store of H. E. Ziecenfuss, which is faced with diabase from California, a settlement 2 miles west. Several houses in Richlandtown also are built of this stone.

New Hope. An historic building of diabase is the house known as Washington's headquarters which stands by the bridge over Pidecock Creek 2 miles south of New Hope. The house is in three parts, of which the middle probably is oldest. The west wing bears a tablet marked 1751. The diabase probably came from Bowman Hill at the other end of the bridge; it has weathered to a light brown. The culvert under the electric railroad 100 feet from the house is fresh and black, but may eventually turn brown. The old mill across the road also is of diabase but covered with stucco.

This rock is very durable, is almost black on fresh fracture and makes somber masonry. It takes many years for it to weather to light brown.

Diabase occurs also in Southampton Township, and in the western corner of the county near Geryville and Trumbauersville and has been used for foundations of buildings. Probably the stone so used was not quarried because some areas are strewn with large and small blocks produced by spheroidal weathering.

The largest quarry in Bucks County is that of the General Crushed Stone Company at Rock Hill, 3 miles southeast of Quakertown. Its face is about 1100 feet long and 130 feet high. The output is 3,000 tons or more of crushed trap daily. Black building stone could be produced if desired.

BUTLER COUNTY.

Butler County is in the middle of the west end of the State just north of Pittsburgh. It is a farming country richly endowed with coal, gas, and oil. The surface rocks throughout the county are the lower Coal Measures. In the valleys of Slippery Rock Creek and in the northeast corner the Pottsville series is above water level.

Limestone occurs in several beds but they are either shaly or so thin as to have no value for building stone, except the Vanport limestone. This latter is 18 feet thick on Rough Run in Winfield Township, and 15 feet on Buffalo Creek at the eastern edge of Clearfield Township. In both places it is a cliff-maker. This limestone has been quarried and burned for lime but I do not know of its being used for building stone. It might be used for rough masonry but because of irregular fracture would be difficult to dress into well-shaped blocks. The Vanport limestone occurs also in the northern part of the county.

Sandstones suitable for building are abundant, however, and have been used. The Buffalo and Mahoning sandstones above the Freeport coal, the Butler and Kittanning sandstones, and the Pottsville conglomerate are the principal sources of building stone.

The Morgantown sandstone is massive, grayish-white, but occurs only in the tops of hills in Adams and Middlesex townships near the Allegheny County line. The horizon of this sandstone has been eroded

but huge residual blocks of it cap the hills and 50 or more years ago had yielded considerable building stone.

The Buffalo sandstone, whose base is about 125 feet above the Upper Freeport coal, outcrops widely throughout the southern half of the county, usually well up in the hills. It is 60 to 70 feet thick, massive, conglomeratic, and resists erosion. Where underlying a flat it strews the surface with loose blocks, and below its cliffy outcrop the hill slope and stream are a wilderness of detached fragments, some the size of a house. This sandstone is particularly thick along Buffalo Creek in Buffalo Township, where with the underlying Mahoning sandstone, it makes a narrow ravine with steep rocky walls. In some places, as in Clinton Township, the Buffalo sandstone is conglomeratic, parts of it being a mass of quartz pebbles. In Penn Township the Buffalo sandstone is exhibited in a cliff and the "Town Rocks" are huge masses of it that have rolled down into the valley of Connoquenessing Creek near the west line of the township. Equally large blocks, "big as a house," are seen on Thorn Creek at the mouth of Patterson Run. Rockdale, a station on the B. & L. E. R. R. near here, gets its name from the size and number of sandstone boulders at its location. In Forward, Butler, and Connoquenessing townships also the Buffalo sandstone is conspicuous and, where it is particularly suited for building stone, it has been quarried.

According to Butts¹ writing in 1902 "On the hills southwest of West Winfield the Saltsburg (Buffalo) sandstone is extensively quarried by the Conemaugh Stone Company of Cresson, Pa. This sandstone practically forms the surface of the flat hilltops and can be reached by a minimum amount of stripping. The quarry already extends over a large space, throughout which the rock varies in thickness from 10 to 15 feet. The rock is coarse-grained, free-working sandstone, in layers of such thickness that it is easily quarried and made into dimension stone of convenient size. It is suitable for coarse masonry only and is used for railroad purposes. The quarried blocks are let down by an incline to the West Winfield Railroad for shipment."

The Mahoning sandstone, where massive, makes a good building stone; it is coarse-grained, nearly white, and dresses well. In Butler County it is not everywhere massive, but with the overlying Buffalo sandstone, makes a wilderness where it is exposed, as on Buffalo Creek. The Mahoning sandstone was quarried over 50 years ago at Hayes Mill in Middlesex Township. It is exposed in the valley of Breakneck Creek from Callery to the vicinity of Mars.

The Freeport sandstone when massive may also be much crossbedded and unsuited for building purposes. Usually it is moderately coarse, light gray, and micaceous but it is said to be unused because of its hardness.

The Butler sandstone is named for its occurrence at the county seat where it is about 50 feet thick, very massive, coarse-grained, reddish white to brown. It has been quarried along the railroad in Summit Township, and is strongly developed in Winfield Township. It is well exposed in the Hobaugh quarry, East Floyd St., Butler.

¹ Butts, Charles, *Economic geology of the Kittanning and Rural Valley quadrangles, Pa.*, U. S. Geol. Survey, Bull. 279, p. 177, 1906.



Fig. 33. Butler sandstone, Hobaugh quarry, East Floyd St., Butler.

The Kittanning sandstone is mentioned as having unusual thickness on Rough Run, above the old Winfield Furnace, which stood where West Winfield is now.



Fig. 34. Clarion sandstone mine at West Winfield, Butler County. The stone is ground for silica sand.

The Clarion sandstone is exposed on Rough Run at creek level near West Winfield and has been mined extensively underground for silica sand. Part of this bed is massive and large blocks of nearly white sandstone could be taken but the outcrop is in a cliffy hillside where quarrying would be impracticable.



Fig. 35. Butler sandstone from Hobough quarry, Court House, Butler.

My own observations were confined to Butler where the number of stone buildings is noticed. The Court House (1885) with its ponderous tower overlooking the square is of greenish sandstone in blocks of random shape and size ranging up to 3' by 36" and 8' by 40". The rock-faced surfaces are much soiled with black soot. Aside from the color, the stone seems to be satisfactory as it dresses well, is strong and durable. This stone, I was told, came from the Hobough quarry which is at the end of East Boyd Street, just under the lip of the hill and overlooking the railroad. The quarry face is 300-400 feet long and exposes at least 30 feet of massive sandstone, overlain by several feet of shaly beds and soil. Joints are nearly at right angles and make a smooth quarry face, though some are slightly curved. The

fresh stone is an attractive reddish white but evidently it loses this fairness after years of exposure and takes on a greenish brown hue. The retaining wall and pillars at the entrance to South Hill addition nearby are of similar local stone and in 1928, being freshly quarried, were good looking stone. The Hobough quarry has not been worked for several years. There used to be three quarries at Butler on three opposing hillsides but they have been built over or abandoned.



Fig. 36. Butler sandstone, Grace Lutheran Church, Butler.

The First United Presbyterian Church (1891) is of local Butler stone, as is also the Second Presbyterian Church (1902) on the square by the Nixon Hotel. It contains blocks up to 4' by 9" and 3' by 12"; the stone work looks thoroughly substantial and durable but it has weathered and stained to a very dirty appearance. Similarly the Bethany Reformed Church (1911), Grace Lutheran Church (1913), the foundation of the Chamber of Commerce building, and St. Paul's R. C. Church (1909) are of Butler sandstone.

The First Methodist Episcopal Church and the base of the High School across the street are Hummelstown brownstone. St. Mark's Lutheran Sunday School (1926) is of stone obtained by breaking loose sandstone blocks on the Lewis Kramer farm two miles west of Butler. This random, rock-faced ashlar with blocks up to 15 inches thick and many with oblique end faces, presented an excellent appearance in 1928, complimentary both to the mason and to the stone, which is buff to tan, some blocks even toned and some streaked.

Tom Wason was quarrying sandstone on George Schaffner's farm in 1928. The quarry is in the steep bank of Butcher Run about two miles south of Butler, and exposes for 50 feet a medium-grained sandstone in heavy beds. He is getting out blocks up to two feet thick and step stones 7 feet long. This sandstone contains weathered feldspar



Fig. 37. Sandstone quarry worked by Tom Wason, 2 miles south of Butler.

that gives the fresh fracture a very light buff color. Ledges below the quarry suggest that there may be as much as 30 feet of massive sandstone at this point. I did not determine its stratigraphic position.

At Slippery Rock the central building of the State Teachers College and a church are built of vari-colored local sandstone. In the church particularly the blocks are rather small, odd sizes, and in strongly contrasted color, making a good example of masonry that should be hidden by stucco.

CAMBRIA COUNTY.

Cambria County, soft coal, Johnstown, and steel are naturally related in the minds of many people. The county lies just southwest of the center of the State on the western slope of the Alleghenies. It is rather rough country, much of the surface is above 2,000 feet, and Laurel Hill with elevations above 2,400 feet is within the west boundary.

The rocks exposed in the county are of Carboniferous age and extend from the Pocono sandstone up to the Conemaugh group, excepting 400 feet of Catskill beds in the gap below Johnstown. The Pocono is exposed in the gap where the river cuts through Laurel Hill 5 miles below Johnstown. It is more than 1,000 feet thick and partly shale. The Pocono sandstone caps the summits along the eastern boundary of the county south from Washington Township. It outcrops in some of the knobs and in places the surface is strewn with large blocks, some of which contain small quartz pebbles. The Loyalhanna limestone which lies between the Pocono and the Mauch Chunk occurs in this gap and also in the loop of the Conemaugh between South Fork and Mineral Point. It is often called the Siliceous limestone but as the quartz grains predominate it might better be called calcareous sandstone. It is about 50 feet thick and much cross-bedded.

The Pottsville conglomerate occurs in these same two places and also along nearly the whole length of the east boundary of the county on Allegheny Mountain, but down the western slope from the crest formed by the Pocono. It is in three parts, the massive Homewood sandstone



Fig. 38. Loyalhanna limestone southeast of Mineral Point, Cambria County. Used for building stone, paving block, and crushed stone. Note crossbedding. Photo by Geo. H. Ashley.

35 to 90 feet thick, about 10 feet of Mercer beds, and the Connoquenessing sandstone about 100 feet thick. Both sandstone members are massive and coarse-grained, white on fresh fracture, and weather gray. The Connoquenessing is gritty in some places.

The sandstones weather out in large blocks, and the country underlain by the Pottsville generally is a wilderness, more or less like the top of Laurel Ridge on the William Penn highway. Also blocks are abundant on the Monohr highway 6 miles southwest of Johnstown on Laurel Hill. The Pottsville caps this ridge from the southwest corner of the county to west of Ebensburg, and occurs also along Clearfield Creek above Fallen Timber.

The Homewood or upper part of the Pottsville sandstone crops along the east side of Clearfield Creek between Dysart and Dean and on the steep slope to the east. The rock is coarse-grained, and in places conglomeratic. Its massive character suits it for bridge work and it has been quarried half way between Dysart and Dean, and also southeast of Dysart by the Conemaugh Stone Company. Blocks lying on the surface in this vicinity are so large and hard that they have been a local source of rubble and building stone.

On the ridge north of Big Spring Gap, and along its outcrop south and east of Onnalinda the surface is covered with great blocks of Pottsville sandstone, some with abundant quartz pebbles.

The Pottsville is quarried on the north bank of Conemaugh River below Coopersdale and crushed. It is tough and well suited to this purpose, and might be used also for rubble. It might be too difficult to dress for dimension stone. The Loyalhanna or Siliceous limestone near here has been quarried and split into paving blocks, and also between Mineral Point and South Fork.

The Clarion and Kittanning sandstones in the lower part of the

Allegheny group are hard, massive, and readily mistaken for the Homewood sandstone. Like it they strew the surface with large blocks. Their thickness is irregular, may be 30 to 60 feet in places, or they may be absent. They have been quarried extensively at Aldburn on Chest Creek for bridge stones used by the Pennsylvania Railroad. The Clarion sandstone has been quarried above Lloydell where a great quantity is in sight.

The Kittanning sandstone, massive and 40 feet thick, crops near the mouth of Paint Creek, and the Butler sandstone is exposed at Moxham. The Mahoning sandstone, just above the Upper Freeport coal, is in the hills around Johnstown and to the south along Stony Creek. It was well exposed at the B. & O. R. R. tunnel south of Moxham. It is massive, coarse-grained, and micaceous, and from 20 to 30 feet thick. It is heavy, coarse, and conglomeratic near Bens Creek Station and in two parts 35 to 40 feet thick, separated by fire clay.

The Mahoning sandstone, in some places is massive and thick, and is conspicuous by reason of its exposure at the surface. A typical



Fig. 39. Mahoning sandstone on Frank Cunningham farm, Patton, Cambria County.

development is on the hills north and west of Patton where it forms a flat surface of considerable extent. On the Frank Cunningham farm just west of Patton, are fields so strewn with large blocks of this sandstone as to be a natural curiosity. Some blocks are 10 feet across. They are a source of local building stone.

The Buffalo sandstone 50 or more feet thick, the top of which is about 200 feet above the Upper Freeport coal, is prominent along the Pennsylvania Railroad near Ehrenfield, west of Summerhill, and north

of Vintondale. It is made up of thick and thin flags, and makes a good deal of heavy debris.

In the hills east of Johnstown a massive sandstone 50 feet thick is believed to be the equivalent of the Saltsburg sandstone. Still higher in the section is the Morgantown sandstone, well developed south of Blacklick Creek and around Ebensburg. At Summerhill this massive sandstone is prominent by the highway bridge, and near Elton. In some places it is thin and insignificant.

The Morgantown sandstone, called also the Ebensburg sandstone because that town is built on it, ranges in thickness from 5 to 150 feet. At Ebensburg it used to be quarried just above the railroad east of the town. At Gallitzin it is massive and contains thick beds of small-pebble conglomerate, which have been quarried, and great boulders occur on sides and top of the hill north of the town. Large blocks occur also on the knoll west of Cresson on which St. Aloysius' Academy stands.

The Wilmore sandstone, the bottom of which is about 520 feet above the Upper Freeport coal, is thin-bedded and micaceous in some places; thick-bedded and coarse in others. It is thin-bedded around Wilmore, but 2 miles north where the road along North Branch crosses a spur it is almost massive. To the north and west, including the spur between North Branch and Sanders Run, large boulders of this sandstone are abundant on the surface.

Building stone quarries are rare in the county, partly because large blocks of float rock are so abundant along the outcrop of the more massive sandstones that in some places all the building stone and rubble needed for miles around can be had by breaking up these blocks. Suitable stone for local use is available throughout the county.

Stone Buildings.

Johnstown. In the newer suburbs on the surrounding hills one is impressed by the number of stone houses, some of them architecturally attractive and with fine landscaping in which stone plays an important part. But in the older city of Johnstown most of the buildings are smoke-stained, frame and mediocre. Stone buildings noted were the First Evangelical Lutheran Church (1919) a fine, clean, large edifice apparently of Port Deposit (Md.) gneiss; the First United Brethren Church (1911) of Hummelstown brownstone; First Evangelical Church (1923) of gray sandstone ashlar said to have been quarried right in the city. This building contains blocks up to 12 by 30 inches, of an even gray stone, and clean after 6 years' exposure.

The First Presbyterian Church (1911) is Ohio sandstone in planed, coursed ashlar ranging in size up to 8 inches by 6 feet. The general effect is gray but top surfaces are stained black. The Baptist Memorial Church (1925) is grayish-tan native sandstone in rock-face random ashlar up to 1 by 2 feet and looks very well.

The City Hall appears to be local sandstone in massive, rock-face, coursed ashlar much discolored, and the U. S. Post Office is white marble.

Local sandstone was used also for some of the bridges and culverts of the Pennsylvania Railroad in this vicinity.

The gate and fence at Grandview Cemetery illustrate the character and usability of the local sandstone.

The Presbyterian Church in Westmont is tan sandstone, possibly Mahoning, from the fields along Menoher highway about 3 miles west near the crossing of Mill Creek. This same locality, at the pines near Mill Creek, was the source of the stone in several recent houses in Westmont and Southmont. Float or field stone is so abundant that it has not been necessary to quarry from a ledge. The rubble is gray but freshly broken stone is tan or gray. Masonry of this native stone looks well and doubtless will be durable. A curious type of masonry common in these suburbs consists of thin rubble mostly laid flat but with many slabs turned on edge, thus producing a spotted effect.

Ebensburg. Cambria County Court House (1881) is brick with sawed yellow Ohio sandstone trim; the new wings are brick with Indiana limestone trim; and the balustrade or ornamental fence is Indiana limestone.

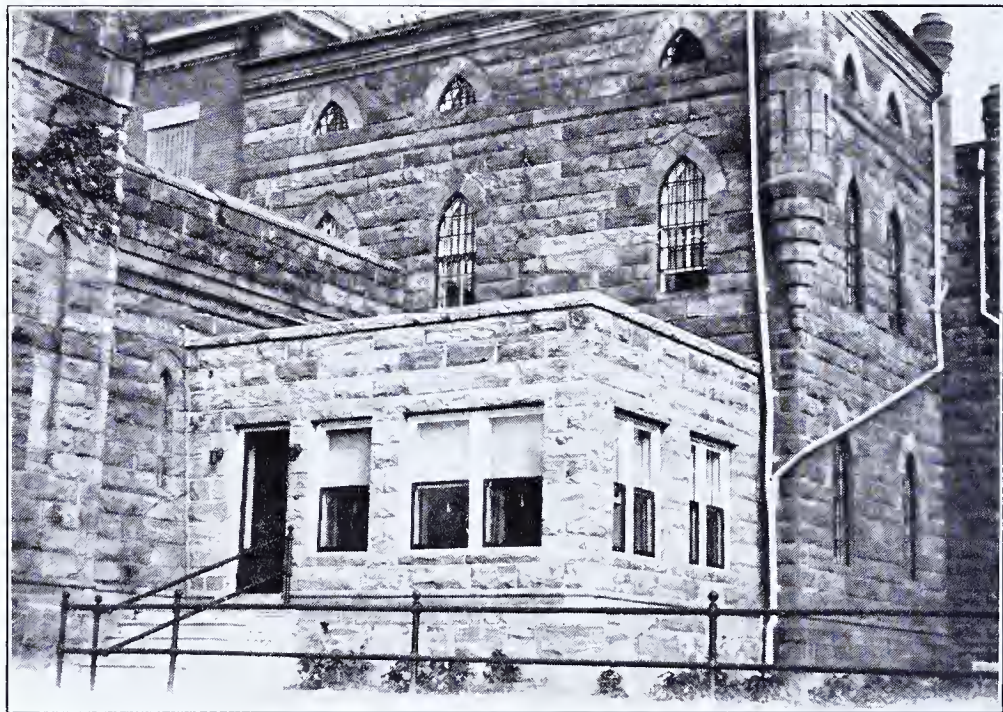


Fig. 40. Mahoning sandstone in county jail, Ebensburg, Cambria County. Shows contrast between weathered masonry built in 1910 and unweathered addition, 1929.

The County Jail (1872, 1910) is of sandstone quarried 3 miles west of town along the Benjamin Franklin highway. This is one of the members near the middle of the Conemaugh group. When freshly quarried the stone is gray, tan and reddish, with streaks of brown iron stain; it weathers or bleaches to gray in 20 years or less and also stains to a nondescript effect by coal soot. This change is indicated by the contrast with the pleasing, light-colored addition of gray, tan-streaked stone from the same source, built in 1928 at the front corner of the jail.

The quarry site 3 miles west of town and 1 mile west of Revloee is in the woods between the highway and the railroad on John Evans

ridge. About 100 yards from the road is an exposure of the top of a massive sandstone, bare of vegetation, with huge blocks separated from the ledge by cracks 10 feet deep and 2 to 4 feet wide. Some blocks bridge gaps so one can walk underneath; hence, the place is sometimes called "the cave." In the woods along side this natural exposure the top layer has been quarried without the aid of machinery.

Other buildings of stone from this locality are the residence of attorney P. J. Little, in Ebensburg, and at Revloc the general store and foundations of the public school and Presbyterian Church (1923).

The First National Bank (1911) at Ebensburg is white marble; the interior is done in verde antique with pink Tennessee marble floor.

Loretto. The estate of Charles M. Schwab at Loretto has several stone buildings, a boundary wall, reservoir, and tower built of native variegated tan-colored sandstone. Part and perhaps most of this stone came from the Frank Cunningham farm on the hill half a mile west of Patton where the Mahoning sandstone strews the surface with large blocks.

Patton. The more massive retaining walls, school house foundation, etc., in Patton are sandstone, probably from the abundant Mahoning float on the Cunningham farm. Some of this stone has quartz grains like rice. The Good Building (1893) has a front of gray sandstone from 2 miles west of Patton, between Thomas Mill and Westover. It is coarse-grained stone, now gray and smoked, but streaked horizontally by the difference in soot-retaining character of the fine and coarse layers. The First National Bank of Patton is Indiana limestone.

Barnesboro. The Roman Catholic Church, lower floor of a school house at the north end of town, and foundations and retaining walls are sandstone obtained by breaking up blocks on the near-by hills. All appear to be good masonry of medium-grain, buff or tan to pink sandstone. This probably is either the Mahoning or Saltsburg sandstone.

CAMERON COUNTY.

Cameron is one of the smaller counties, one of the most thinly populated, with only 16 people per square mile, and one of the least cultivated areas in the State. It is a lumbering and hunting region between Clearfield and Potter counties, and crossed by Sinnemahoning Creek. Of its 392 square miles, 78 per cent is forest. Practically half of the population lives at Emporium, where an iron furnace formerly gave considerable employment; the furnace has been cold for several years and now the principal occupation at Emporium is the manufacture of radio tubes.

With a total population of less than 7,000, and nearly half of these people in one community, it is readily understood that there is little need for building stone for local use.

Rocks of the lower part of the Allegheny group cap the hills in the northwest corner of the county and in the syncline between Cameron and Emporium. Large areas are underlain by the Pottsville or Oleon conglomerate, and still larger areas by the Pocono sandstone. These heavy beds underlie the upland or broad plateau with a general altitude of 2,000 feet, and rim the upper parts of the valleys by which the tableland is deeply dissected.

The Catskill beds form the walls of the valleys throughout the county. The lowest beds coming to the surface in Cameron County are the Chemung rocks and these are exposed only in the main valleys within 2 to 6 miles of Emporium.

I was told at Emporium that building stone has not been quarried near there in many years because the hard bluestone is thin bedded, and most of the thicker stone is soft and irregularly bedded.

In the business street of Emporium are two or three stores with fronts of brownstone, and the Episcopal Church (1901) is brownstone, but questionably of Triassic age. The Presbyterian Church (1903) is brick on a foundation of fine-grained green Ohio sandstone, and St. Mark's Roman Catholic Church is brick with native sandstone base and Ohio (?) sandstone steps.

The main roads through the county follow the main streams and give little opportunity for one to see the principal source of local building stone, which would be the Pocono or Pottsville sandstones well up in the hills or on the upland.

Flagstone is quarried $2\frac{1}{2}$ and 6 miles from Sinnamahoning by Gust Johnson for J. G. Robinson of Philadelphia. In 1931 fifteen cars of large flags up to 8 by 10 feet in size were shipped to Washington, D. C., for paving around the tomb of the Unknown Soldier.

CARBON COUNTY.

Carbon County extends from the anthracite fields at Lansford well up into the Pocono Mountains, and is nearly bisected by Lehigh River. Mauch Chunk is the county seat. Settlement is concentrated along the river below the mouth of Nesquehoning Creek and in the anthracite region.

The rock formations exposed in the county range from the Medina sandstone up to the Coal Measures. The Medina occurs only in Blue Mountain, and the Helderberg limestone in the valley of Lizard and Aquashicola creeks; the Oriskany sandstone makes the ridge along the north side of these valleys. Devonian sandstones and shales make a parallel belt several miles wide across the southeastern part of the county, or between Palmerton and Mauch Chunk.

Broad, Pohopoko, Scrub, Mauch Chunk and Call mountains are capped by Pocono sandstone, and the Mauch Chunk red shale and sandstone are well exposed at the town and westward along the valleys of Mauch Chunk and Nesquehoning creeks; also in the valley of Quakake Creek and along Lehigh River north of Penn Haven Junction.

Red sandstone in the Mauch Chunk series is quarried on the east bank of Lehigh River half a mile above the bridge at Lehigh Tannery by the White Haven Stone Products Co., Inc., of Hazelton. Overburden of soil and disintegrated sandstone 10 to 20 feet thick is removed and a clean face of massive sandstone about 25 feet thick has been worked for 200 feet. The principal products are curbstone, paving blocks, and crushed stone, but building stone can be furnished on demand.

The Pottsville conglomerate occurs in Nesquehoning and Pisgah mountains around the Panther Creek basin, in Spring Mountain and other high land between Audenreid and Weatherly.

So far as learned, building stone is not being quarried in the county at present, although several prominent buildings attest former production of durable material. One of the largest stone structures in the county is the Court House at Mauch Chunk, which is faced with red-banded tough sandstone quarried from the Mauch Chunk formation at Rockport, a few miles farther up Lehigh River. This building, erected in 1893, is rock-face random ashlar but looks fairly clean in spite of the proximity to two railroads. The trim is Hummelstown brownstone, which, incidentally, is failing.

In the rural districts and small villages the principal stone masonry is rubble foundations of buildings and the handiest stone is used. Where the Pocono sandstone is at the surface, walls are gray, and where the Mauch Chunk formation outcrops, walls are red. In some places, as Mahoning Valley west of Lehigh, where wash from the Pocono is mixed with that of the Catskill beds, one sees walls that contain a mixture of gray, red, and greenish sandstone.

Stone Buildings.

Mauch Chunk. Beside the Carbon County Court House mentioned above, is a soldiers Monument on a base of what looks like the local Pottsville conglomerate. Back of the Y. M. C. A. building is an old block of houses of dressed sandstone, possibly of Pocono age. On the same street is St. Mark's Episcopal Church, begun in 1867, done in light tan, gray, and brownish sandstone, probably quarried near by. The dress-face, coursed ashlar probably made a handsome building but years of exposure to the smoke of the town and passing trains has masked much of the former color. This church is unusually large and handsome for the size of the town and is rather unique in its location, being perched on a niche cut in a very steep hillside. The masonry appears to be in good condition and the stone certainly is durable. The interior of this church is very fine, including black walnut wood work and Minton floor tiles.

St. John's Lutheran Church (1915) on the hill is of stone similar to that of the Episcopal Church.

East Mauch Chunk. Retaining walls, foundations, and whole houses in this town are built of rubble and dressed sandstone and conglomerate. The material comes from the nearby mountain side on Route 903 where Pocono formation float is abundant. St. John's Episcopal (1867) and St. John's Evangelical Lutheran (1924) churches are built of this stone in variegated colors. The Roman Catholic Church (1897) is dark gray granite from outside the State.

Lansford. The War Memorial in the square at Lansford is a large boulder of Pottsville conglomerate with $\frac{1}{2}$ "-1" white quartz pebbles. This rock is abundant on the mountain near by.

Trinity Evangelical Lutheran Church (1928) is built of mica schist from Mt. Airy or Chestnut Hill, Philadelphia. The stone is steel gray, glinty with mica, and rusty on some faces, all making a very pleasing appearance.

St. Michael's R. C. Church (1908) is blue-banded white marble from Gouverneur, Saint Lawrence County, New York. It looks clean and nice after more than 20 years.

Summit Hill. No stone building was seen in the town but founda-

tions and walls of various kinds are built of the local Pottsville conglomerate in which white quartz pebbles up to an inch in diameter are abundant. This stone can be obtained in abundance without quarrying, from loose blocks on the surface.

Lehighton. The High School (1916) is reddish granite from Seisholtzville, Berks County. Zion Reformed Church (1915) has a foundation of rock-faced Hummelstown brownstone, and water table of the same stone dressed smooth. Some of the blocks have weathered in 15 years so that the tool dressing is obliterated in places, and a few are cracked. The walls of the church are faced with granite gneiss from Holmesburg, Philadelphia County. This stone has a slight greenish tinge now, but looks very well. All Saints Episcopal Church (1906) is a gray, massive, coarse-grained sandstone, stained dark. It was quarried at Bowmantown and it may be the Pocono sandstone.

The gate posts at Lehighton cemetery, built in 1928, are Pocono sandstone and fine conglomerate from the mountain back of East Mauch Chunk. The fresh faces are tan, buff, reddish, and gray and make a pleasing appearance. This stone is abundant on the mountain side and probably was float rather than freshly quarried.

Pottsville conglomerate has been used effectively at Lehighton in some private rock gardens.

CENTRE COUNTY.

So named because of its geographical situation in the State, Centre County is the second largest, and only 1 to 4 square miles larger than Bradford, Clearfield, and Tioga counties. The county may be described as a great limestone valley bounded on the east and south by mountains of folded Devonian rocks, and on the west by Allegheny Mountain. Bellefonte and Philipsburg, each with about 4,000 people, and State College with 2,500, are the larger towns.

The limestone of Nittany valley is of Cambro-Ordovician age, Beek-



Fig. 41. Chazy-Black River limestone quarry, Oak Hall, Centre County.

mantown, etc., and has been burned in many places for building and land plaster. The Ordovician limestone is quarried extensively for flux and lime. It has been used also for building stone, as seen in farm houses, and particularly at State College in several new fraternity houses. Some are dark blue limestone, some light gray; the dark stone may become gray after many years of exposure. The quarry at Oak Hall 3 miles east of State College is one source of this building stone.

Bald Eagle valley is partly underlain by Helderberg limestone, which has been used locally for building stone.

The Seven Mountains, Tussey, Brush, Nittany, and Bald Eagle mountains are formed largely of Medina sandstone and large blocks of float are so abundant that it has not been necessary to open quarries to get this stone for building purposes. Some slopes are liberally strewn with massive blocks within easy access of a road, and in and near these mountains the vari-colored Medina is the common building stone. One source is Bald Eagle Ridge near Bellefonte, another is $1\frac{1}{2}$ miles east of Pleasant Gap near the watering trough on the road to Centre Hall, and another on Tussey Mountain near Boalsburg. The Medina furnishes some distinctly different stone, some being all red and some very light or nearly white. A building of either one of these colors, done in ashlar and well pointed has a more pleasing appearance than one in mixed rubble too closely resembling a crazy quilt.

Red sandstone of the Catskill beds along the flank of Allegheny Mountain has been used for building purposes, but not always successfully.

The Pocono sandstone makes the crest of Allegheny Mountain, and outcrops also along Susquehanna River in Burnside Township, and the Pottsville conglomerate occupies the surface in many square miles of wilderness west of Allegheny Mountain.

No part of this large county lacks or is more than 3 miles from stone suitable for common building rubble, and much of this stone is fit to make into ashlar.

Stone Buildings.

Bellefonte. The County Jail (about 1865) is built of yellow conglomerate containing small quartz pebbles that was obtained on top of Allegheny Mountain east of Snowshoe. The Roman Catholic Church, front of the Elks Club, and the Robert Valentine house (now owned by Judge E. L. Orvis) at Curtin and Allegheny Streets are of the same stone, according to A. J. Cook and other old residents of Bellefonte. This probably is Pottsville conglomerate.

The First National Bank (1872) on the corner of the diamond has walls of yellow Ohio sandstone and foundation of pebble conglomerate from Allegheny Mountain. The trim is brownstone, some blocks of which are cracked.

The general effect of this mountain stone is gray, but the fresh stone is light tan, buff, or gray and rarely reddish. That in the Catholic Church is rock-face random ashlar and from a distance looks like coarse granite. Blocks in the water table are up to 5 feet long.

The Valentine house at the corner of High and Spring Streets, the oldest in town (built about 1800) and still standing in 1929, and the Linn house (1810) are local limestone. Several other buildings and many walls in Bellefonte are of limestone quarried on the northwest edge of town. The stone in this quarry is hard and is said to be more

suitable for building than that at Pleasant Gap, which is nearly pure lime. Some of the limestone used in structures in Bellefonte has weathered white, and curiously other blocks presumably from the same quarry and having similar relief and exposure are stained black. If this is a characteristic of Bellefonte limestone that some weather white and some black, then some care and study should be used in its selection for building stone, because oddly placed black ashlar in an otherwise white wall do not produce a pleasing effect. Where all blocks weather to the same light gray or white, the appearance of house walls is attractive. One explanation of the dark blocks is that they are more porous, absorb moisture, and so collect soot from the atmosphere.

St. John's Reformed Church (1880) is built of yellowish sandstone with rare quartz pebbles, and trimmed with Hummelstown brownstone. The rock face ashlar is now darkened by weather staining. Presumably the pebbly sandstone is Pottsville conglomerate from Allegheny Mountain.

The First Presbyterian Church (1868) is an example of the failure of an unproved stone. There seems to have been a desire for a brownstone edifice, and as red sandstone was available in the Catskill beds along the slope of Allegheny Mountain only a few miles from town, it was quarried on Wallace Run above Gum Stump and used, rather than employing more expensive brownstone from the eastern part of the State. The stone was not known by previous use to be durable and less than 20 years of exposure in the walls of the church proved its poor quality. Spalling is common, many blocks exhibiting a shelly character, and recession of faces is pronounced. Cap stones on the buttresses are much reduced in thickness and disintegration by scaling is conspicuous all over the exterior walls. As this spalling is said to occur mostly in winter, it is assumed that the stone is too porous, absorbs moisture, and breaks by freezing.

The residence of W. J. Reynolds at Linn and Allegheny Streets is of Hummelstown brownstone (1883) in perfect condition. The house of John Walker on Linn Street is red sandstone from the slope of Allegheny Mountain. The locality and age of the stone were not learned but it indicates that some red sandstone from that vicinity is more durable than others. The Bush House built of brick in 1868-9 has a limestone foundation, part of which, along the creek, is exposed to severe conditions but seems to be durable.

Centre Hall. The principal stone buildings here are two churches, Trinity Reformed (1853-1895) and St. Luke's Lutheran (1885). Both are of red and greenish red sandstone in large blocks with both rock and joint faces. The stone came from the red Medina or Juniata sandstone at the bend of the road by the water trough on the west side of Nittany Mountain one mile from the summit. Many blocks in these churches are 1 by 2 feet and some water table stones are up to 4½ feet long. Some of this stone resembles that from White Haven, Luzerne County. Trinity Church is built of large rectangular blocks laid random, with small square blocks interspersed, an unusual type of masonry. It is pointed in red mortar and makes a good appearance.

Milheim and Aaronsburg have little stone masonry except foundations. These are of the local gray limestone and red Juniata sandstone from the adjacent hills. At Woodward the only stone building noted

is Woodward Inn (1814), which has thick walls of limestone. The front is ashlar, with some large smooth blocks; the ends are smaller, rougher, and less regular blocks. The color is light and dark gray to grayish green.

State College. The number of stone buildings in State College, particularly residences and fraternity houses, is notable. Limestone houses are mostly very light gray; some of the newer ones are dark limestone but it turns buff in a very few years and is an even gray



Fig. 42. Ordovician limestone in Theta Kappa Phi house, State College, Centre County.

in 10 years. The site of the open air theatre opposite the new Mining Building, is a quarry from which limestone was obtained in 1853 for building Old Main College. The limestone salvaged from Old Main was used in the new Administration Building.

The reddish sandstone buildings are Juniata sandstone from Nittany Mountain, and the more variegated buildings are Oswego sandstone from Nittany, Tussey or Bald Eagle Mountain. Commonly the blocks of float stone from the mountains are hauled to town and shaped and dressed on the job. If laid as ashlar and not too variegated, this mountain stone makes an attractive house; much more so than varie-



Fig. 43. Tuscarora quartzite rubble in fraternity house, State College, Centre County.

gated rubble pointed in white. The latter style is “jazzy” like a crazy quilt. The Myers house at Allen St. and Nittany Ave. is of red Juniata sandstone from a small quarry near Old Locust public camp about $\frac{1}{2}$ mile south of Potters Mill. The stone has good appearance and works well.

I was told that all the mountain stone used at State College is floor stone; that the red Juniata from near Boalsburg is hard to dress in comparison with the light Oswego sandstone. On the campus of State College near the Armory is an obelisk built of selected specimens of sedimentary rock representing each of the principal geologic ages. Archean rocks are at the base, Pocono near the middle, and Triassic at the top. This polyolith should be a measure of the weathering quality of building stone from many parts of the State.

Philipsburg. The principal stone buildings in Philipsburg are churches and a bank and all are of sandstone taken within 2 or 3 miles of town and mostly from loose surface blocks. The stratigraphic position of this stone was not determined but it is believed to be Butler or Mahoning sandstone.

The Hale Stone Building (1873) occupied by the First National Bank is native sandstone in coursed ashlar. The general tone is gray and the lowest courses are very dark, but in the upper walls one can still see traces of tan. Should the building be cleaned by sandblast it doubtless would be a light tan like the recent additions to the churches. This stone probably was from float on the Hale estate, where large blocks for the Pennsylvania Railroad bridge over Susquehanna River at Rockville were taken later from a quarry opened for the purpose.

The Episcopal Church (1911); Presbyterian Church (1908), and addition (1928); and Trinity Methodist Episcopal Church () with a large addition (1927) show the effect of weather in 20 years. The additions have a general light tan tone but the church erected 20 years

ago is gray with tan and red showing in protected places. Some of this stone, including that in the addition to Trinity M. E. Church, came from a hill 2 miles southwest of Philipsburg where John Cushard gets building stone. Here are blocks of coarse sandstone up to 6 by 8 feet across and 1 to 3 feet thick that he breaks into fairly even ashlar. Some of the rock is reddish, some variegated, and some has dark brown weather lines, but the general effect of the fresh faces in a wall is light tan. It bleaches eventually to light gray. This is near the horizon of the Mahoning sandstone.

The George Holdren house on Philips Avenue at the east end of town is small blocks of red sandstone from the foot of Allegheny Mountain on the Tyrone road 2 miles north of Bald Eagle. This building is so new that there is no evidence as to the durability of the stone, which may be from the Catskill group of rocks.

CHESTER COUNTY.

Chester County, established in 1682 and named in honor of the native place of William Penn, is in the southeastern corner of the State, adjoining both Maryland and Delaware. Although the eastern end of the county is so close to Philadelphia that it is a suburban residence district for city business people, nevertheless the county has fewer people per square mile than Lancaster County. This probably is because Chester County has smaller areas of good soil. West Chester, the county seat, laid out in 1786, is the site of a State Teachers' College; at Coatesville 3,000 men are employed in steel works; Valley Forge is on the northeast boundary of the county; and the Kennett Square-West Grove district is known as a great producer of mushroom rooms.

Chester County is divided into two nearly equal parts by a narrow east-west limestone valley, which is followed by the Pennsylvania Railroad. Each part contains a large area of gabbro, gneiss, and schist. Marble and many small patches and one large one of serpentine occur in the southern half, and the northern half has a considerable area of Triassic sediments along the northern border, with two large patches of trap. A great belt of mica and chlorite schist bounds the limestone valley on the south and quartzite bounds it on the north. There are then in this county the following varieties of building stone: gabbro, gneiss, schist, serpentine, quartzite, limestone, marble, and sandstone. Many buildings throughout the county, particularly old ones, are of stone, such as Washington's headquarters at Valley Forge, Washington's and LaFayette's headquarters at Chadds Ford, the old inn at Green Tree, and the old church on Meetinghouse Creek. Very few quarries now produce building stone. The larger quarries are producing either crushed stone for highways and concrete, or limestone to be burned into lime.

Beginning at the northern end of the county, the following description of things I have seen will proceed south. At Saint Peters, at the falls of French Creek $\frac{3}{4}$ mile north of Knauertown the French Creek Granite Company is quarrying diabase or "black granite" for monuments. The property has been in operation nearly 50 years and now has a pit from 20 to 150 feet deep well down in unaltered rock. The product is rough-faced and polished monument stock, and paving blocks. Polished surfaces are black and the fresh fracture is dark gray. Some of the rubble from quarrying and dressing large

blocks is sold occasionally for building stone, but the freight rate and the dark color of the stone make the demand small. From 30 to 75 men are employed.

Near the surface the rock shows typical spheroidal weathering due to disintegrating along joints. The resulting rounded blocks are hard but not suited for monument stock and the interstices are filled with residual sandy material. At depth, however, the rock is perfectly sound, very massive, with few joints in evidence and breaks with regular, but slightly curving fracture, as shown in the accompanying illustration. (Fig 44).



Fig. 44. Diabase quarry at St. Peters, Chester County. The finished product is polished monument stock marketed as "black granite."

Quarrying and squaring the rough blocks is done with compressed air drills. The blocks are raised from the quarry to the rough dressing ground by derricks with long booms, and after being squared are moved to the shop on small flat cars. In 1931 about 25 men were working in the quarry and yard, and about 25 in the finishing department. Two men were making paving blocks. Some of the rough pieces from squaring the large blocks are sold for building stone, but

the principal output of the company is polished monument stock. Specimens of this "black granite" can be found in many prominent cemeteries, especially in the Philadelphia district, in Baltimore, Brooklyn, New York City, and Cleveland, Ohio.

This trap is the country rock along the Saint Peters Branch of the Reading Railroad from Saint Peters to Elverson and the surface is strewn with large bowlders of it. Some have been gathered in fences and used for foundation walls. The National Bank and some houses at Elverson are built of the stone which is called "French Creek granite."

Phoenixville and Spring City are built on Triassic shale and buildings of native stone are rare. Valley Forge is on the contact between this shale and Chickies quartzite and the latter rock has been used in foundations, retaining walls, and a few buildings, including Washington's headquarters, a small two-story stone house at the mouth of Valley Creek. The Washington Memorial Chapel at Valley Forge is built of gneiss from Holmesburg, Philadelphia County, and trimmed with Indiana limestone.

In the hilly country between Phoenixville and Honeybrook and from Birchrunville to Sadsburyville the bedrock is mostly granite, gabbro, and gneiss. One quarry at Cornog is getting out crushed stone but I know of none that makes building stone. In this area one finds stone fences made by assembling bowlders from the fields, and foundations from the same source, and maybe including two or three different kinds of rock. As this surface material of different kinds of rock is usually in rather small blocks, some are iron-stained, colors differ, etc., a wall built of it does not look well, so stone houses in this district commonly have an exterior coat of plaster. A. Suger-man & Sons at Devault are producing crushed monzonite but can furnish nice building stone if wanted, for some of this granitic rock breaks with parallel flat faces.

Chickies quartzite forming a ridge or line of hills along the north side of Chester County Valley is mostly a tough quartzite but contains some softer, micaceous layers. It tends to make rock floes in places and this readily available material was used in the early days for building purposes. Two miles northwest of Downingtown and just below Fisherville are an old mill, barn, and house (the Edge place) built of native stone, mostly quartzite. Records show there was a building here between 1720-27, probably the wing of the house next to the road. The adjoining part of the house was built in 1768 and the mill maybe about the same time. The main part of the present residence is not so old and the stone porch was added in 1925. Much of the stone in these buildings probably was taken from the banks of Beaver Creek without quarrying. Some blocks expose micaceous faces with small black tourmaline needles. The large door stones and all the rest of the old masonry are in fine condition.

Mr. Edward Wirth of Downingtown was quarrying Chickies quartzite in the end of the ridge at Fisherville in 1927. The beds strike N.60°E and dip S.E.35°. As much difficulty has been found in drilling this very hard rock, it is broken out by barring and working sticks of dynamite into the cracks. Large blocks are then mauled to one-man size. Small black tourmaline crystals are common and green chlorite (?) is developed along some seams. Rough stone is delivered

to the user by auto truck. The East Downingtown High School and three or four houses near it are built of this stone, as are also a new house (1927) near Wirth's limestone quarry one mile east of the quartzite quarry, the William J. Mitchell house half a mile north of Thorndale, and the Josiah Phillips house two doors from the Baptist Church at Downingtown.

Cave Rock quarry owned by Edward Wirth, one mile northwest of Downingtown on the Horseshoe Pike, provides limestone for building purposes. The quarry has been opened for 500 feet along the strike of beds dipping S. 50° and is 20 feet deep. The joints are vertical or at a slight angle to the bedding and from a few inches to 2 feet apart. The stone is light gray with faint blue markings. Garages, a church, and some houses at the east end of Coatesville are of this stone; also the East Downingtown public school.

Lewis and John Baldwin own a limestone quarry near Bradford Hills Station $1\frac{1}{2}$ miles east of Downingtown, but it has not been worked in recent years. The quarry is large and old, the deeper part flooded, and kilns remain, though long in disuse. The bedding is nearly vertical. The stone is mostly gray but ranges from very dark to nearly white. The white limestone is coarsely crystalline. Much of the stone is banded, and runs all the combinations of light and dark, thin and thick bands. Building stone to give variegated effects could be obtained here. A blue, fine-textured limestone from a quarry near Downingtown opened in 1831, was used in building Villanova College, Villanova Station, railroad bridge abutments and piers.

According to *Geology of Pennsylvania*, 1858, p. 215: "A little south of the Valley turnpike, about three and a half miles east of Downingtown, is the extensive quarry of superior white marble which has for many years supplied Philadelphia with the beautiful article employed in so many of its public and private edifices. It is on the farm of John R. Thomas. The beds on this quarry are slightly contorted. The portion worked for the marble separates into two bands. The rock occurs in massive beds, chiefly white, with sometimes a bluish tinge, and is quarried with great facility. It has been much used in the construction of the Girard College and other public buildings which adorn Philadelphia and the neighboring towns."

These old quarries, now owned by George Thomas 3d, are half a mile southeast of Whitford. One now used for a swimming pool is about 250 feet long, 75 feet wide, and 20 feet above water. Another now used for a trash dump is about twice as large, and a third parallel but narrower is smoothly grassed. The large dumps likewise now are all grassed over. The beds dip at high angles, up to 70° . Pure white marble was only part of the product, for nearby houses and barns are mostly bluish marble.

Founders Building, Girard College, built in 1832, is designed after the Parthenon. The walls are marble in coursed ashlar, blocks being 20 to 30 inches thick and up to 9 feet long. They are weathered to gray, stained muddy color in places, and fresh, clean, and blue on the northeast corner where rain washed. The 36 fluted columns of 11 drums each, resting on 9-foot, round pedestals, have been patched in several places where a fluting has broken. The surfaces shed sand easily, which consists of angular grains of calcite and rare mica flakes. The



Fig. 45. Pennsylvania marble in Founders Building (1832), Girard College, Philadelphia.



Fig. 46. Marble exposed in Pennsylvania Railroad west of Valley Creek, east of Downingtown, Chester County.

steps are blue-gray banded marble in blocks 10 feet long. Many of them are cracked along the bedding and some have patches set in.

Perhaps "other public buildings" includes the old Customs House and Girard Bank. In July 1927 I viewed the front of the Customs House at Fifth and Chestnut Streets, Philadelphia, and found that while the steps are in good condition (possibly not the original steps) and the square sawed blocks of the front wall are in fair shape, the eight fluted columns are badly spalled. Likewise the old Girard Trust Company Bank on Third Street below Chestnut at the Stock Exchange Place has a marble front including a portico with broad steps and six columns. The building was closed and for sale in 1927 and much of the marble in a sorry state. Many of the corners and edges are rounded, some faces are slightly spalled, and the fluting of the pilasters is chipped and cracked. It also is very noticeable that the bases of some of the columns are cracked and patched with inlays where pieces have broken out. The window sills are in particularly bad condition. These buildings suggest that some at least of the Chester Valley marble is not durable in the atmosphere of downtown Philadelphia. In 75 years it has deteriorated sadly. On the other hand, thousands of white marble door steps in Philadelphia that have been scrubbed frequently are in excellent condition after 50 or more years of constant exposure to the same atmosphere and the abrasion of passing feet.

Marble is well exposed along the Pennsylvania Railroad west of Valley Creek, east of Downingtown.

Between Malvern and Devault are several large limestone quarries. The Knickerbocker Lime Company plant at Mill Lane, $1\frac{1}{4}$ miles northwest of Malvern, is in a quarry about half a mile long in steeply dipping beds. The wing of a church on the Lincoln Highway at Frazer, and a home next door, are limestone from the Mill Lane quarry. Samuel Given's quarry near by has a face nearly 100 feet high in steeply dipping beds of light colored limestone. The product is crushed. The Cedar Hollow quarry of Charles Warner Company at Devault is a very large pit worked in three benches, and supplying stone to a large lime plant. A quarry of the Knickerbocker Lime Company at Cedar Hollow supplies stone for the kilns at Mill Lane. All of these quarries could furnish building stone, but there is no demand for it.

The Paoli monument near Malvern, erected in 1877 on the centennial of the massacre at that point, is Quincy (Massachusetts) granite.

Waynesborough, the birthplace of General Anthony Wayne, a stone house south of Paoli built in 1724, is of rubble consisting of gneiss, granite and trap gathered on the farm.

South of the Downingtown Valley in the area underlain by schistose rocks, stone buildings are not common.

The Cockeysville marble has been quarried in the vicinity of Doc Run, Avondale, and Landenberg. The purer rock, when fresh, is a medium-grained, crystalline saccharoidal marble. It is shiny white and some of it contains an abundance of amber scales of phlogopite. This mica may be scattered so as to resemble granite or it may be so thick along a bedding plane as to resemble mica schist. It is surrounded by Wissahickon gneiss except where it borders on quartzite.

I have seen only three quarries in this marble. One on the south side of the railroad nearly a mile west of the station at Avondale was operated by the Avondale Quarry Company. This excavation is 700

feet long, parallel with the railroad, and 150 feet wide. The dip is south at a low angle into the hill. The pit is flooded. A marble mill building and a large derrick stand at one end of the pit. No quarrying has been done here in recent years. The marble is coarsely crystalline, white and blue, and some blue-banded. Phlogopite is abundant in some beds. This quarry was worked many years by Frank Williamson & Company, 2302 Spruce Street, Philadelphia and supplied facing stone for the following buildings:

Fire Engine House, Gay Street, West Chester, 1887; St. Paul Reformed Church, Waynesboro, 1897; St. Mary's P. E. Church, Wayne, 1890; Roman Catholic Church of Epiphany, 11th & Jackson Streets, Philadelphia, 1899; Church at 43d and Chestnut Streets, Philadelphia, 1887; Apartment House, 35th & Powelton Avenue, Philadelphia, 1913; Residence "Wheatly," Lancaster, 1894; St. John's Lutheran Church, Lancaster, 1890; North Reformed Church, Passaic, N. J., 1890; National Bank, Haddonfield, N. J., 1893; First Methodist Church, 6th & Stevens Streets, Camden, N. J., 1892; Trinity P. E. Church, Wilmington, Delaware, 1888; National Bank, Newark, Delaware, 1888.

Another is a small opening at the railroad crossing just west. It has long been idle but was once worked for lime, as evidenced by the old kilns.

The only quarry in Cockeysville marble that has been worked recently is on the Pomeroy Branch of the Pennsylvania Railroad 13 $\frac{1}{4}$

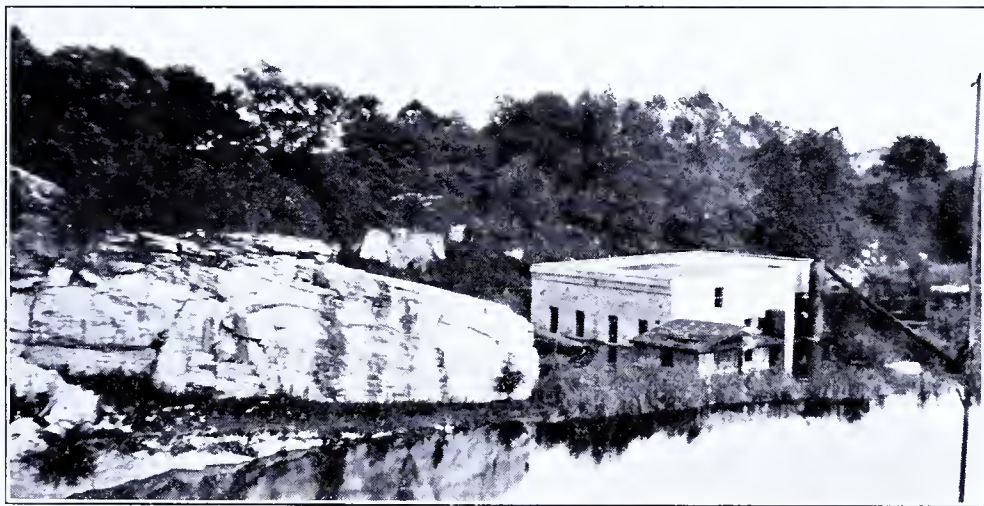


Fig. 47. Cockeysville marble quarry at Bakers Station, Chester County.

miles northwest of Avondale and just beyond Baker Station. It is the property of the Pennsylvania Marble and Granite Company of Philadelphia and was leased by H. L. McLimans of West Grove in 1927. This quarry is several hundred feet long in white marble dipping south at a low angle. It is said to be 70 to 90 feet deep but is now flooded, water partly submerging the marble mill building that stands below the brink. A bank of seven lime kilns at the south end of the quarry has long been unused. The company used to quarry with channeling machines, and ship finished and polished blocks, but according to hearsay, they had a big order for rough stone, got it out with dynamite, and ruined the quarry for further output of finished marble.



Fig. 48. Cockeysville marble quarry, Bakers Station, Chester County, where stone was taken for St. Patricks parochial school in Kennett Square.

In 1927 McLimans employed one man drilling with compressed air and 3 men roughing out blocks taken from the north end of the quarry just above water level. The marble obtained here is white with faint blue and pink banding. It was used in St. Patrick's parochial school, Kennett Square, built in 1927. Blocks were dressed on the job and



Fig. 49. Cockeysville marble from Avondale in U. S. Post Office, West Chester. Built in 1909.

ranged up to 10 inches thick and 5 feet long. This quarry also furnished the marble for the Roman Catholic Church at Fourth and Grant Streets, Wilmington, Delaware, finished in 1927. Other examples of the use of Cockeysville marble from these quarries near Avondale are the United States Post Office (about 1909) and Westminster Presbyterian Church (1899) at West Chester; the front wall and gate posts of a factory at the railroad station in Kennett Square; gate posts at a cemetery in Kennett Square; Dingee & Conrad Company building (1915) at West Grove; and a school house between Baker and Avondale built in 1887. The marble walls of this building are gray. It would be interesting to know whether the marble was gray originally or has turned from white to gray in 40 years or less. As this is a country school house the gray can hardly be ascribed to discoloration by smoke. This marble is said to bear a pressure of 22,500 pounds per square inch.

A formation known as Setters quartzite that outcrops around Upland and London Grove also flanks the south side of the ridge between Avondale and Toughkenamon and is quarried for building stone be-



Fig. 50. Quarry in Setters quartzite formation, Avondale, Chester County producing building stone and rough flags.

tween these places. The quarries of H. L. McLinans and William N. Worrall are close together at the base of the hill about half a mile east of Avondale. Worrall's property, known as the Avondale Colonial building and flagstone quarry, has a crescentic face about 150 feet long and 40 to 50 feet high and employs six men. The beds strike along the ridge and dip S.30°. They are hard, micaceous quartzite and softer micaceous sandstone of light and dark shade but no definite color. Some breaks in thin slabs, and some in blocks 6 inches thick. Much



Fig. 51. Old hotel at Avondale, Chester County, built of local Setters quartzite.



Fig. 52. Micaceous sandstone (Setters formation) from Avondale, in First Baptist Church, Kennett Square, Chester County.

of it is brown stained on one or more faces. Some of the more massive stone that is decidedly blue on fresh fracture, looks like a gneiss.

In McLimans' quarry the strike varies in direction but the dip is $S.30^{\circ}$. Joints are 6 inches to 7 feet apart. Those that have a $N.15^{\circ}$ course dip $N.W.70^{\circ}$, but cross joints trending $N.80^{\circ}W$, are vertical. Drilling is by hand and blasting loosens the rock, most of which comes out in slabs not over 6 inches thick. Some 2 inch flags are used for walks. The quarry face is 200 feet long and up to 75 feet high.

In 1931 Joseph Rotunno was quarrying next to McLimans. His product includes sills and flags. Rusty quartzite, which Rotunno calls brownstone, is marketed as well as fresh stone from deep in the quarry.

The stone from these quarries, known as Avondale stone, is seen in Avondale Inn, (Fig. 51) now about 150 years old, in stores and garage at Avondale, Kennett Square Presbyterian Church, and First Baptist Church (1925). In the Baptist Church the quartzite is in blocks 3 to 6 inches thick and up to 40 inches long. (Fig. 52). Blocks in the wall showing greater thickness are slabs on edge. Cross jointing in the quarry is indicated by the numerous oblique ends of blocks in the finished wall. Abundant mica gives a glint, and iron staining relieves any color monotony. This same stone was used in the steps and walks of the Baptist church.

Serpentine.

Another building stone occurring in the southern half of Chester County and formerly much used is serpentine. It is in many isolated patches, and in one large area of several square miles in the southwest corner of the county along the State line. The largest production came from the Brinton quarry (now used as a country club's swimming pool) on Radley Run 3 miles south of West Chester. Fifty years ago serpentine was much used for facing buildings in Philadelphia and vicinity. Several buildings at the University of Pennsylvania, and many residences throughout the city were faced with this green stone. Time has shown its defects. When exposed to the atmosphere of a city it slowly disintegrates and the surface spalls. As a result very little serpentine has been quarried in Delaware and Chester counties in the present century. Therefore the quarries need not be described. Suffice it to say that this metamorphic rock may be both massive and banded, so closely jointed and shot with calcite veins as to be valueless, it may be soft or hard, clear green or mottled, and the discovery of a place where it will yield building stone to dress into ashlar is difficult.

The Church of the Holy Trinity in West Chester shows serious deterioration of serpentine. When completed probably it was a beautiful edifice, but the color has faded and many blacks have spalled badly, especially the cornice in the tower.

The West Chester State Teachers' College is a group of several large buildings in which serpentine is the principal material. A happy digression was made in 1925 when the Memorial Building was constructed of mica schist. In these buildings the only uniformity is the use of green serpentine, for one building is random smooth-face ashlar, (Fig. 53) and another is rock-faced, one is smooth-faced rubble and another is mixed random ashlar and rubble. The main part of the Administration Building (1872) of squared, dress-faced blocks shows



Fig. 53. Chester County serpentine, random ashlar, with marble trim, in girl's dormitory, State Teachers College, West Chester.



Fig. 54. Chester County serpentine in gymnasium, State Teachers College, West Chester, shows failure of cut stone cornice.

a little spalling but not bad; later additions to this building show deep spalling, especially around the foundation. The gymnasium is dress-faced rubble with an ornamental carved entrance that is badly dis-

figured by chips weathering out. The library and model school are rock-faced rubble, and having been built within the last few years do not show deterioration of the serpentine. (Fig. 55). In Recitation Hall (1892) the first story is rough-faced rubble, second story squared, smooth-faced ashlar, and third story dress-faced rubble, a curious combination and yet not strikingly bizarre. The serpentine is in reasonably good condition.



Fig. 55. Chester County serpentine rubble in Model School, State Teachers College, West Chester.

Although some people argue that serpentine deteriorates faster in the polluted atmosphere of the city than in the country, and although the older buildings in West Chester show more spalling than those of recent construction, yet the evidence at State Teachers' College suggests that blocks which have been wrought or tooled the most, like carvings, cornices, and dressed faces, go to pieces first.

A small but old serpentine quarry in "the barrens" 2 miles southwest of Nottingham, owned by Harry Rhodewalt, probably was the source of the stone in Nottingham Presbyterian Church (1878). The walls are gray and green rubble, some sandy, some glassy texture. The corners and door frame are dressed serpentine and the window sills are gneiss. Some blocks show slight spalling but this masonry is good for centuries. Rhodewalt furnished stone from this quarry in 1927 for the William Galbreath house, Mt Vernon Street, Oxford. This quarry runs into the hill about 60 feet and has a face 20 feet high. The serpentine is so closely and irregularly jointed that irregular blocks are barred out and all shaping is done by the mason.

Schist and Gneiss.

Although the country rock in a considerable area in the eastern part of Chester County is gneiss, schist, and gabbro, I do not know of a building stone quarry in these rocks. This may be partly because the

gneiss quarry at Port Deposit, Maryland, is only a few miles south of Oxford on the Pennsylvania Railroad. A house across the street from the First Baptist Church at Kennett Square is built of Port Deposit gneiss.



Fig. 56. Mica schist from Broomall, Delaware County, in Memorial Building, State Teachers College, West Chester.



Fig. 57. Mica schist in St. Agnes R. C. Church, West Chester.

The Memorial Building at the State Teachers' College is mica schist from Broomall, Delaware County, and the Roman Catholic Church at West Chester, built in 1925, is a beautiful structure of mica schist said to have been quarried at Llenerch or Broomall. The stone is laid as random ashlar, and the variety of color, greenish, steel gray, and silvery smooth-dressed faces, with rusty joints, gives a very pleasing effect. The micaceous faces glisten in the sun and the recessed joints make contrasting shadow. The trim on this church is Indiana limestone, and the sidewalk is red and green slate.

Saint Agnes parochial school and residence adjoining the church appear to be gneiss from Port Deposit, Maryland.

At London Grove several barns, houses, and Friends Meeting House are of schist, quartz, and quartzite, evidently field stone and not from a quarry.

Several houses in Oxford are of granite gneiss said to have come from near Avondale. Perhaps this "granite" was quarried with the marble at Baker Station. The George Hanna house, 4th Street and Lincoln Road, is vein quartz, milky, yellow, and iron-stained, giving a somewhat pibald effect. This quartz was gathered from float in the woods near town. Four houses across the street are blue and white micaceous marble from near Avondale.

CLARION COUNTY.

A French word, meaning "clear, bright," first applied to the river, was given also to the county in northwestern Pennsylvania which the river biseects. Clarion County, with an area of 601 square miles, has a wholly rural population of 36,000. The only building stone is sandstone, for although the Vanport limestone is present, it is so closely bedded and jointed that rarely can dimension stone be taken. It has been used for flux, fertilizer, and macadam.

The sandstones range in age from the Mahoning above the Upper Freeport coal in the hilltops to the Burgoon sandstone of Pocono age in the Clarion River and Deer Creek gorges. The Mahoning sandstone stratigraphically is the highest in the county and occurs only in hilltops in the southern part. It is massive and conglomeratic in places but like some other Coal Measure sandstones, it weathers to an unattractive greenish brown hue. The Freeport sandstone next below is generally coarse-grained or even finely conglomeratic, and likewise occurs only in the southern part of the county. The Kittanning sandstone is medium-grained and commonly has a pinkish tint on fresh fracture. This in a few years fades to dull gray. Curbing was once made from this sandstone in a quarry two miles south of Strattonville.

The Clarion sandstone lies below the Clarion coal and clay but is not everywhere present. Where well developed it is a coarse-grained, thick bedded member 15 to 20 feet thick, resistant to weathering, and strewing the surface with firm blocks. On fresh fracture it is gray, pink, or light tan, and will retain these pleasing colors for many years in a clean atmosphere. It outcrops close around Clarion, and probably is the stone used there for building purposes. Inquiring at the Court

House as to the source of the sandstone in it and the jail, I was told that the stone came from the hillside half a mile south where float was abundant. The brick Court House built in 1884-5 has a thick foundation and interior cellar walls of dressed sandstone, and most of the jail, excepting the brick front, is massive stonework. The stone is in regular tiers about one foot thick, and blocks range up to 6 feet long. The main wall is rock-faced, the water table dressed smooth, and the base coarses are cut with horizontal ribbing. The stone is composed of uniform grains of clear quartz. It has weathered to buff or tan, but a hint of the original pink tint can still be seen although the jail was built in 1873. The stone is durable.

The First Presbyterian and First Methodist Episcopal churches at Clarion, and the chapel at the State Teachers College are of native sandstone dressed to rock face. A new front entrance built on the chapel in 1928 of the same stone as the rest of the building contrasted the freshly broken and weathered stone, for the entrance is a charming light tan with a tinge of red, and the rest of the building is weathered dark. Blocks a foot or more thick and up to 7 feet long show the size of dimension stone that can be taken from the local float stone.

In Clarion, house foundations of well dressed local sandstone are common.

At Shippenville rather massive sandstone outcrops and float is abundant. Retaining walls and house foundations of dressed stone 8 inches thick and 24-30 inches long were observed. Here too the slabby field stone has been used for building a church but the deeply raked mortar joints are too wide; a similarly built house at the east end of the village looks better because the mortar joints are thinner.

It may be the Clarion sandstone also that was used for the memorial wall at the spring at the east end of the bridge over Clarion River on Lakes-to-Sea Highway. This wall is 25 feet long and 6-9 feet high with a central panel arch flanked by bench seats. The stone is light buff, pink to reddish, and lightly streaked sandstone in regular coarses 7 inches thick, and cut in blocks 4-5 feet long. The arch and keystone over the panel from which the spring issues are of alternate red and buff stones. This memorial was built in 1927, and being out in the country may be expected to retain its coloring longer than if in town.

The massive sandstones of the Pottsville series and the Burgoon sandstone of Pocono age outcrop in the river gorges and in tributary ravines. These sandstones are coarse-grained, more or less friable, and not colored so much as the sandstones described above. They weather to dull gray, and on fresh fracture are light gray to white, being highly siliceous. The Homewood and Connoquenessing sandstones of the Pottsville series have been quarried near Upper Hillville and north of Foxburg for silica sand. The quarries were near the top of the river bluff where the sandstone is 30-50 feet thick, and some layers are only loosely consolidated, so that the stone easily crushes to sand. The Connoquenessing outcropping in the gorge of Clarion River above Clarion probably is the source of great blocks 10-20 feet across that are so abundant in the woods 150 feet or more below the outcrop. The sandstone is exposed also on Redbank Creek in the vicinity of Leatherwood and in some of the ravines tributary to Clarion River and Piney Creek. I did not learn of the Pottsville sandstones having been used for building stone, although doubtless plenty of places could be found where the quality would be satisfactory. There

is little demand for stone however, in rural communities, except for road building.

The Kittanning sandstone has been quarried for curbing 2 miles south of Strattonville. It is medium coarse-grained, and is slightly pinkish when fresh, but weathers to dull gray. This or a lower sandstone was quarried at Catfish in Madison Township many years ago; at least the stone in the jail at Kittanning is reported to have come from Catfish in 1870. It may have been from float blocks.

CLEARFIELD COUNTY

Clearfield, one of the large counties, lies just west of the center of the State. It is generally high, many of the ridge tops being 1,500 to 2,000 feet above sea level. West Branch of Susquehanna River crosses the county in a narrow valley with walls, in places very steep, rising 400 to 500 feet above it.

The rocks exposed include from the Conemaugh group to the Pocono sandstone. The Pocono is exposed along Susquehanna River below Bald Hill, on Moshannon Creek for several miles above its mouth, and on several northern tributaries of the river between Anderson Creek and Three Run. The Pottsville conglomerate outcrops all along Susquehanna River and its tributaries and underlies a broad belt of upland extending from Forest to the northeast corner of the county.

I find nothing about these rocks in earlier reports except their distribution and have seen only a small part of the county myself. Only one quarry was producing building stone in 1928 but that was a big one.

Roaring Run quarry. At the head of Roaring Run about 2½ miles north of Curwensville and only a few rods from the highway along the east rim of the valley is a sandstone quarry that has been open for many years and has yielded a large quantity of stone. This quar-

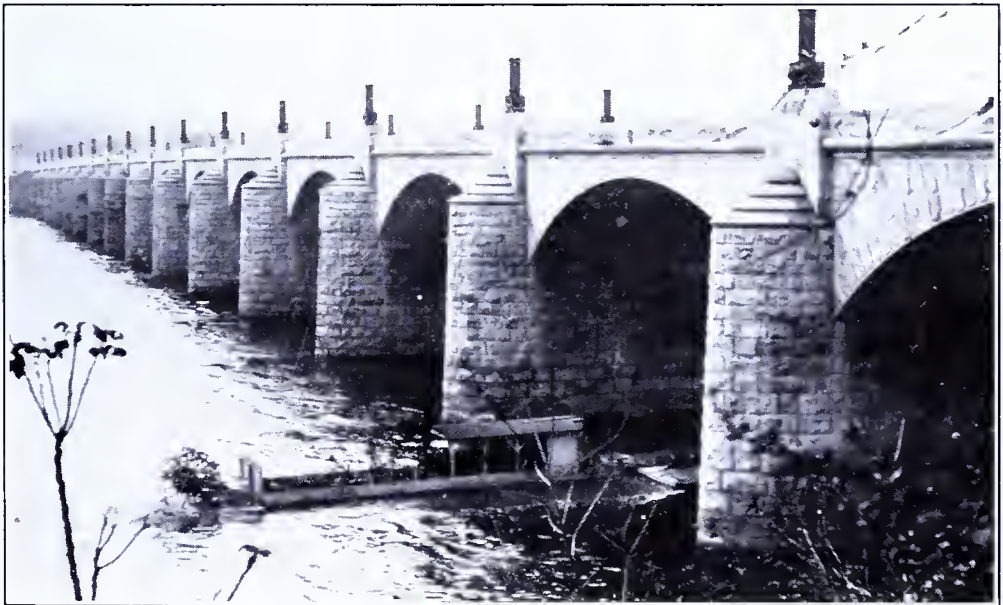


Fig. 58. Market Street bridge, Harrisburg; piers and arches are sandstone from Koppel, Beaver County and Curwensville, Clearfield County. Top is Indiana limestone. Completed in 1928.

ry was opened originally by Charles Patton. He sold it to the Roaring Run Quarry Co. and they to the Manheim Refractories Co. In 1932 it is being operated by the Pennsylvania Sandstone Company. After being idle 13 years the quarry was worked through out the season of 1922 but only 3 months in 1923 and in 1924. From 1925 to 1928 the quarry produced large quantities of stone for the Princeton University chapel at Princeton, N. J., for the Market Street bridge across Susquehanna River at Harrisburg, and for the Pittsburgh museum. Stone from this quarry was used for retaining walls and steps at the Art Museum, in the Parkway, Philadelphia.

The upland north of Curwensville is underlain by the Pottsville conglomerate, a massive sandstone and conglomerate formation which outcrops along the rim of the plateau or at the top of the steeply cut slope of Roaring Run. In some places the stone is more deeply weathered or more friable than in others, but at the head of Roaring Run it seems to be especially dense and hard and suitable for heavy masonry work. A quarry opened on this rimrock has followed along the outcrop for about 300 yards, taking out a massive sandstone in a single bed 20 to 25 feet thick. The outcrop has been followed rather than to strip the increasingly heavy overburden encountered back from the outcrop.

The newly quarried rock ranges from a warm flesh color to light gray and weathers to medium gray. Blocks 18 by 24 by 60 inches can readily be taken and larger ones on demand. The quarry is equipped with five derrick booms operated by steam winches, and with 2-inch tripod drills. The Roaring Run Railroad following down the valley bottom has been torn up and the stone from the quarry is now hauled by auto truck on the highway. The stone is shaped and dressed at a shop at the mouth of Roaring Run. This shop has a 4-gang saw, several compressed-air dressing machines, and is served by a railroad spur. In 1928 about 30 men were employed at this stone yard on the railroad at the mouth of Roaring Run. They were using air-operated machines for shaping large surfaces and cutting designs and making smooth and rock-faced random ashlar, sills, lintels, and special jobs, in gray, yellowish tan, and reddish sandstone. There seems to be more demand for the slightly tinted than for the clear gray stone. A large pile of waste at the quarry, including blocks up to 3 by 6 feet, shows the gray tone to which this rock weathers and how much it hardens on exposure. (It is reported that all stone dressing was done at the quarry in 1931, the use of the yard at the mouth of Roaring Run having been discontinued.)

Two miles north of Curwensville on the west side of the highway near the W. T. Wink farm the massive, gray, sugary sandstone of the Pottsville Series has been opened at two points. The northern quarry has a face about 100 feet long and 15 feet high; the southern quarry is smaller. Neither has been worked in several years. A large quantity of building stone could be removed in large blocks with almost no stripping.



Fig. 59. Sandstone quarry of C. T. Eastburn on Roaring Run, 2 miles north of Curwensville, Clearfield County. Shows facilities for producing large blocks and large quantities of stone. Photo from C. T. Eastburn.

Bloom Run quarry. A quarry that is notable for the size and quality of the stone and for the structures in which it was used is the Bloom Run quarry 4 miles north of Grampian. This high plateau country is underlain by the Pottsville conglomerate which outcrops around the rim or at the top of the steep valley walls. The Bloom Run quarry overlooks Anderson Creek and the B. R. & P. R. R. The quarry was opened by Whittaker & Sweeney, and sold by them to Drake & Stratton. A light railroad was built along the rim to handle the product of the quarry and incidentally that of several small quarries started where cuts made for the railroad opened up the ledge. The main quarry is several hundred feet long, narrow, and 20 to 40 feet deep. By stripping a few feet of thin-bedded sandstone, a massive bed 20 to 25 feet thick was uncovered. This massive sandstone splits readily into blocks 18 to 30 inches and up to 12 feet long. The large blocks are admirably adapted for heavy masonry and were



Fig. 60. Pottsville conglomerate quarry on Blooms Run, Clearfield County. This stone was used for Pennsylvania Railroad bridges, including the mile-long bridge at Rockville.

used in some notable construction. The Pennsylvania Railroad main line stone arch bridge across Susquehanna River at Rockville, above Harrisburg, the longest stone arch bridge in the world, is built in part of stone from the Bloom Run quarry. Some other bridges on the Pennsylvania Railroad and the electric railway subways in Philadelphia also are of this stone. This stone is much like that from the Roaring Run quarry. It is a medium-grained quartzose sandstone, rather soft and sugary when fresh quarried, but becoming harder on exposure. It is generally gray but may be stained or tinted pink or light tan by iron.

The Bloom Run quarry has been idle since about 1920 and the railroad built to it has been torn up. The quantity and character of stone remaining to be quarried is judged to be satisfactory and perhaps some day operations will be resumed here. A quantity of stone

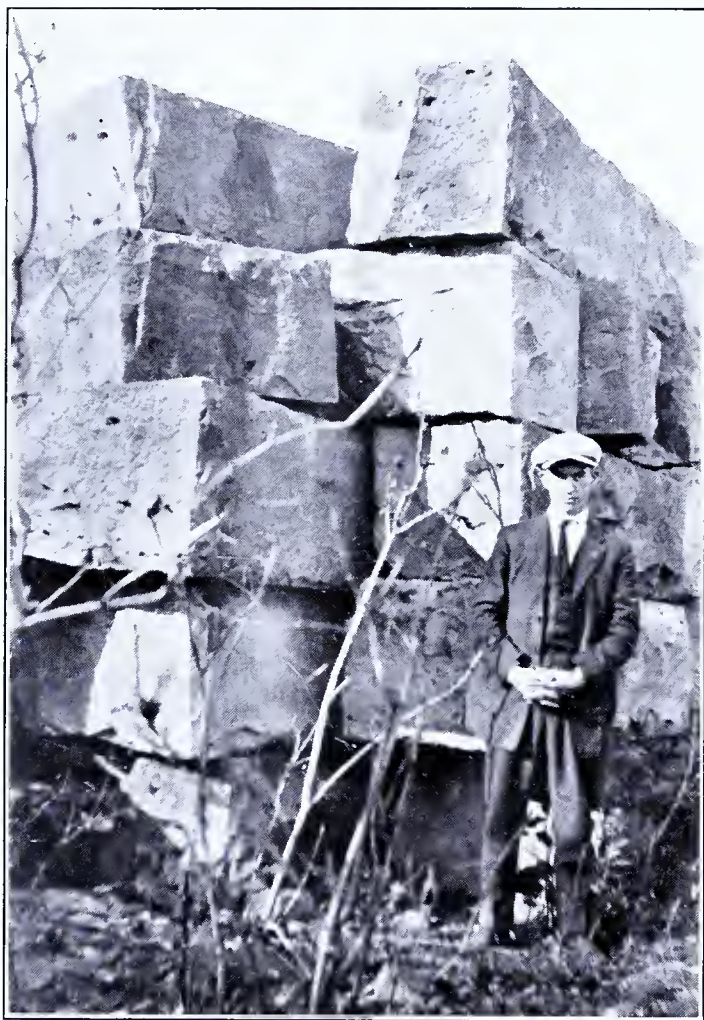


Fig. 61. Pottsville conglomerate on Blooms Run, Clearfield County, for bridges and other heavy masonry.

blocks of large size piled along the railroad right of way near the quarries is already for loading. Many persons who have traveled over the highway across Clearfield County will remember the pile of large stone blocks just below the highway a short distance east of Grampian. The blocks are from the Bloom Run quarry. They measure 20 to 24 inches thick, 30 to 36 inches wide, and 5 to 7 feet long, and are like the blocks sent from this quarry to Harrisburg for the Pennsylvania Railroad bridge at Rockville. Their position along the railroad right of way makes them easily accessible.

Another quarry that furnished large sandstone blocks for the Rockville bridge is along the road on Buenavista Hill, about 2 miles west of McGees Mills. This same rock, the Clarion sandstone, is exposed in

the railroad cuts at McGees Mills. It is light-brown, irregular bedded, about 40 feet thick and conglomeratic toward the bottom. The Homewood sandstone also outcrops at McGees Mills but does not make prominent cliffs or seem suited for building stone.

Two churches and a residence in Curwensville are of the local sandstone.

DuBois. The DuBois Hotel, several churches, foundations of schools, residences, etc. are of medium-grain, quartzose, sugary sandstone from a local quarry. The fresh stone is gray, some of it weathers to tan, but all of it in a few years is blackened by soft coal smoke. The quarry is at the foot of a hill on the northwest edge of town just south of the B. R. & P. R. R. yards. The face is 250 feet long and up to 50 feet high. The upper 10 feet is shelly and the rest is massive but with numerous curving joints. Blocks up to 8 or 10 feet long can be raised. Many blocks in the DuBois Hotel are 15 inches thick, and 2 to 3 feet long, the main courses are 8 to 10 inches thick, and one sill is 1 by 6 feet. A derrick mast and stone crusher in the quarry suggest that the latest production was crushed stone but the quarry has been idle several years and is in the hands of a receiver.

Clearfield. Several notable buildings in Clearfield are of native stone but inquiry seemed to indicate that practically all the stone was obtained by breaking loose blocks of sandstone found on the surface. Only one quarry for building stone was seen, and that, several miles from town and well up the hill on the road to Roehnton, is only about 10 by 50 feet and has not been worked for years. It lies on the north side of the road just back of where loose blocks of Homewood (?) sandstone up to 10 by 20 feet in size were quarried in 1927-28. It is a gray sandstone of fairly even grain with a faint tan color on some blocks, and a really attractive building stone when freshly quarried. The Trinity parish house (1927) of the Methodist Episcopal church is like this stone and may be from this locality.

The Methodist Episcopal Church (1904) is gray sandstone composed of clear, coarse quartz grains, in blocks up to 15 inches thick, but not lengthy. They are laid as rock-faced random ashlar and are not badly smoked stained. I believe the parish house will weather and stain to the same color.

The Presbyterian church at Clearfield, said to be copied from a church in England, is native sandstone dressed and laid as random ashlar. The blocks are neither smooth nor rock-faced, just rough dressed. Some stones have cracked along the bedding, some across the bedding, and a few have spalled. This does not mean that the stone around Clearfield is not durable; only that the stone should be selected. Twisted columns beside and carvings above the main entrance also are of the native stone. This church is an example of erratic staining, of which I have not found an explanation. With equal relief, roughness, and exposure, some blocks are almost black and others are scarcely stained at all.

CLINTON COUNTY.

Though many people may not know where Clinton County is, they do know the location of Lock Haven, the county seat. Clinton lies north of Centre County and is crossed by the West Branch of the

Susquehanna River. Except for the limestone valleys in the southeast end of the county, it is mostly a high dissected plateau or mountain ridges, and mostly in timber. Settlement is concentrated in a few spots, about half the population being huddled in Lock Haven, Flemington, Mill Hall, Renovo and Avis.

Because of the folds in the geologic structure east of Allegheny Mountain a long series of rock formations is exposed in Clinton County. The oldest is Cambro-Ordovician (Trenton or Beekmantown) limestone. It occupies the lower part of Nippenose Valley, is found in Sugar Valley along Fishing Creek from Carroll to Tylerville, and underlies Nittany Valley in a belt up to 3 miles wide.

The hard, weather-resisting Medina and Oneida sandstones make all the higher elevations in this end of the county, including Nittany, Sugar Valley, Big, and Bald Eagle Mountains and all the high land draining to McElhattan Creek.

The valley of Bald Eagle Creek and of the Susquehanna below Lock Haven is underlain by Helderburg limestone, and the slope rising to Allegheny Mountain by Devonian beds, including Portage flags and Catskill red sandstone. A line of knobs on the north side of the limestone and extending from Beech Creek village northeast for 5 miles, is made by the Oriskany sandstone.

Pocono sandstone forms the steep scarp of the Allegheny Front at an elevation of 1,200 to 1,600 feet but it dips rapidly to the west and occupies the valleys of all streams in the county west of the Front. It is the cliff making rock at or just above water level along the Susquehanna from Queens Run to the Cameron County line, along the whole length of Tangaseootach, Queens, Lick, Backer, Youngwomans-town, Kettle, and other creeks and runs. Above the Pocono sandstone is the Mauch Chunk red shale, and above it the Pottsville or Olean conglomerate making all of the upland in the county west of the Allegheny Front. Small patches of Allegheny group rocks cap the hills on the west side of the Susquehanna from Hyners Run to the southwest corner of the county, and along Allegheny Mountain.

There is therefore a considerable number of formations from which building stone may be obtained.

In the valleys south of Bald Eagle Mountain the limestone has been used for house and barn foundations and is quarried at Salona for crushed stone. In these rural districts there is no demand for building stone and any need has been satisfied by breaking surface blocks or a handy ledge. The same is true of the Medina sandstone in the mountains. Float is so abundant in places that it has not been necessary to open quarries to supply the small local needs.

In Lock Haven, Flemington and Mill Hall the common stone for rubble foundations, retaining walls, etc. is field stone from Bald Eagle Mountain, gneiss-like rock from the Medina. It has been used also in a few houses for the whole structure and with pleasing effect, for the freshly broken stone exhibits variegated light colors.

The County Court House (1869) at Lock Haven is brick on a smooth, hand-dressed ashlar foundation of fine-grained, gray, pink, and tan sandstone conjectured to have come from the Medina on Bald Eagle Mountain or from the Pocono on Queens Run. The first story front is said to be Ohio sandstone, and the present steps, blocks up to 10 feet long, are thought to have been quarried in Queens Run, which was the source of many of the curbstones used in Lock Haven. These

quarries ceased operation about 50 years ago. The masonry in the Court House walls has recently been cleaned by sandblast. The County jail (1851-2) built of brick in the front and stone in the rear, was remodeled in 1871-2.

St. Paul's Episcopal Church (1856-7) is built of yellow-gray siliceous sandstone in coursed ashlar, the source of which was not learned. The stone is scaling so fast that from across the street the color impression is of fresh stone. Close view shows the whole face of some blocks coming off. Stone for the addition to this church came from Farrandsville Furnace on the Susquehanna a few miles above Lock Haven and probably is Pocono sandstone.

The First National Bank (1913) and Clinton Trust Company building have sawed brownstone fronts, and the Citizens Hose Company building (1918) at the corner of West Park Street and Seventh Avenue is brownstone.

St. Lukes Reformed Church (1902) and the U. S. Post Office are brick, trimmed with Indiana limestone.

The only stone quarry noted that seems to have been worked recently is about 4 miles above Lock Haven in the south bank of the West Branch and opposite the clay mine of the Northern Refractories Company. Here flags have been taken from close to the road back up the dip 150 feet probably in Catskill beds.

At Renovo the principal use of native stone has been rubble for foundations and lawn retaining walls. The cliffs of Pocono or Pottsville sandstone are conspicuous in the mountain sides overhanging the town. No quarries have been opened, for surface stone is abundant. The Zion Evangelical Lutheran Church (1906) is Hummelstown brownstone in good condition, as is also the base of the Masonic Temple (1912). Indiana limestone was used in the front of one bank in Renovo.

From the above description it will be understood that stone suitable for local buildings is abundant from one end of the county to the other and is mostly Medina, Pocono, and Pottsville sandstone, but includes limestone, and flags.

COLUMBIA COUNTY.

This county is on the North Branch of Susquehanna River between Luzerne and Northumberland counties. It has some high and wild country at the north end where Sugarloaf Township rides up onto the Pocono plateau. A broad belt of Catskill, Chemung, and Hamilton beds makes hilly country as far south as the ridges of Pocono sandstone known as Huntingdon, Lee, and Knob mountains that extend from Orangeville east to the county line. The lowest land is where the Helderberg limestone crops out from Bloomsburg to Berwick along the north shore of the river, and then loops back through Light Street to Forsty Valley.

South of the Susquehanna are Nescopeck and Catawissa mountains made of Pocono sandstone, and then Little Mountain, of the same rock, making the northern boundary of the anthracite field in Conyngham Township. A large area in Locust and Roaring Creek townships has more moderate relief because it is underlain by the softer Catskill formation.

The geologic formations exposed in the county range from the Clin-

ton red shale formation up to the Coal Measures. The principal sources of building stone therefore are the Helderberg limestone, the Pocono sandstone, Pottsville conglomerate, and the sandstones in the Chemung and Catskill formations. The Oriskany sandstone crops out for only a few miles in Forsty Valley.

Quarries are few in Columbia County. There are limestone quarries in the bluff along the railroad north of Almedia and at Lime Ridge 5 miles east of Bloomsburg from which rubble could be obtained, also in the east bank of Little Fishing Creek two miles above Bloomsburg, but these are idle or worked only intermittently for lime. They are in Helderberg limestone. Sandstone has been quarried in the creek bluff south of Catawissa where Catskill beds are exposed, and stone used locally for foundations and for an occasional building may have been obtained here. Sandstone probably of Pocono age is reported to have been quarried many years ago near Central in the extreme northern end of the county. A fine building stone was available about 4 miles above Central but it was so hard to bring down the mountain and so far from a railroad that after being worked 5 to 6 years near the turn of the century and getting out stone for two churches it was abandoned.

Stone Buildings.

At Catawissa foundations commonly are of black and greenish slabby sandstone taken from outcrops of the Catskill formation in the creek bank. An old 3-story warehouse at the east side of the village is of this native stone. The Catawissa National Bank is faced with Indiana limestone and trimmed with polished verde antique.

In Bloomsburg I noticed only the First M. E. Church (1896) which is built of medium grained blue, gray, and green sandstone said to have been quarried near Central, in the northern end of the county. It is of rock-faced random ashlar 4 to 10 inches thick and after 35 years still presents a very neat appearance. An addition built in 1927 is said to be of Warsaw bluestone from Portageville, New York.

There are no stone buildings in Benton but at the bridge 1½ miles north is the Bruce Cole house built of thin slabby bluestone. Similar stone is exposed in the creek bank and probably the material for the house was quarried near by. In the ends of the house the bluestone was laid flat, but the large blocks making the front elevation probably are on edge as are the corner quoins. A tablet set in the wall is inscribed "Aug. 20 W & E Cole, 1836." The masonry looks good for another hundred years.

CRAWFORD COUNTY.

Crawford County joins Erie County on the south. It was named for Col. William Crawford, who was captured by Indians and burned at the stake at Sandusky, Ohio, in 1782. In Crawford County the only natural building stone occurring in quantity is sandstone in the Pottsville and Pocono series. These sandstones are wide-spread and furnish suitable material, as is shown by houses, churches, and retaining walls that have endured for many years without apparent deterioration.

At Cambridge Springs, sandstone probably in the base of the Pocono has been quarried at the head of a ravine just south of the borough. A pond now fills the quarry but the stone produced here is well ex-

hibited in the foundation and exterior stairways of the Polish College, a large brick building (formerly a hotel) on a hill. The sandstone is fine-grained, thin-bedded, gray-green, and some is fossiliferous, limonite filling molds of small shells. In the foundations of the main building,



Fig. 62. Local sandstone (Catskill?) in Polish College, Cambridge Springs, Crawford County.

the stones are 7 to 8 inches thick and 4 to 5 feet long. Basement window sills and stairs to porches are larger stone. The retaining wall at the west end of the building is thinner slabs, averaging not over 4 inches thick, but from 20 inches to 5 feet long. Some of these thinner stones are crazed like shale on the exposed edge, some are split along the bedding, and some are stained very black, but most of them are clean gray and free from cracks. From the evidence here it is apparent that some of the thin-bedded stone is not durable. This building was erected about 30 years ago, and burned in 1931.

The foundation of the Barrett Hotel is similar stone and may be from the same quarry, but the gray sandstone in St. Anthony's Catholic Church is believed to be from Ohio.

At Meadville a quarry in the Sharon conglomerate has furnished stone for more than 50 years and is still operating. It is on North Main Street extension $\frac{3}{4}$ mile beyond Allegheny College and now operated by the Penn Silicon Company for silica sand, with an occasional output of building stone. Very little stripping of glacial material is required to uncover the ledge. The quarry face is about 200 feet long and 35 feet high. The upper 20 feet shows more or less bedding but the lower 15 feet is massive and increasingly pebbly toward the bottom. The stone freshly quarried is soft, sugary, and yellowish or light buff, but hardens on exposure and weathers to an even cadet gray. The stone is durable except that which contains many pebbles. On exposure unequal expansion causes the pebbles to loosen and break out from the matrix. In 1880, I. C. White of the Second Geological Survey wrote that the "coping stones of the M. E. Church have al-

ready begun to decay." In my opinion this disintegration rarely goes far enough to weaken the stone.

The Methodist Episcopal Church (1866) and Christ Protestant Episcopal Church (1883) on the diamond in Meadville are built of stone from this quarry. They are stained black, especially where trees



Fig. 63. Pottsville sandstone quarry, Penn Silicon Co., Meadville, Crawford County.



Fig. 64. Pottsville sandstone, Allegheny College observatory, Meadville, Crawford County.

are near, but show little sign of spawling or other disintegration. The First Baptist Church, also on the diamond is Hummelstown brown-stone, but the Court House, built in 1868, is of local sandstone.

The observatory at Allegheny College, Meadville, also was built (1901) of sandstone from the quarry nearby. Blocks up to 15 inches thick and over 4 feet long make the walls. The cornices and fluted pillars flanking the door were dressed by hand and show what can be done with this stone.

It is evident that Meadville could supply dimension stone in considerable quantity should there be a demand for it. A lower sandstone outcropping at Meadville is dark grayish brown and might be even more durable but its color is against it for building stone.

This lower sandstone, called the Shenango sandstone by the Second Survey, was quarried extensively on a hill 2 miles southwest of Evansburg for facing the locks of the Beaver-Erie canal completed in 1844. Here it is coarse-grained, massive, light brown, and contains fossil fish remains and iron ore balls. Similar stone and reddish white Sharon conglomerate were quarried near Atlantic, East Fallowfield Township, many years ago for building purposes; also a 6-foot sandstone was worked 1 mile east of Linesville.

Another locality where large blocks were taken for building locks in the old canal was 2 miles southeast of Conneautville. Here, according to I. C. White, the Corry sandstone is 8 feet thick but only the lower 5 feet was used. The stone is fine-grained, buffish-white, in layers 6 to 12 inches thick.

White and yellow massive sandstone was quarried also in Jackson and Unger runs in East Fallowfield Township, in a ravine a mile west of Adamsville and in the ridge just east of Jamestown. Operations here were 50 years ago; the stone commonly had carbonized fossil plant remains, fish remains, and was specked with iron. It worked fairly well, hardened on exposure and eventually became brownish rather than gray. Stone from the Jackson Run locality was used for bridges and culverts on the railroad that follows the ridge through East Fallowfield Township. Some quarries in this part of the country worked on bluish-gray, flaggy sandstone in beds 8 to 12 inches thick.

CUMBERLAND COUNTY.

Extending west from Susquehenna River at Harrisburg along the Great Valley between North and South Mountains to Shippensburg on the Franklin County line, Cumberland County was settled early by farmers attracted by the good soil of the broad limestone valley. Cambro-Ordovician limestones, largely magnesian, underlie an east-west belt 2 to 8 miles wide. Martinsburg shales of Ordovician age make another broad area between the limestone and North Mountain, which exposes the massive sandstones of basal Silurian age along its crest.

South of the limestone is a narrow band of siliceous sandstone and quartzite, possibly the Hardiston quartzite of basal Cambrian age, and in South Mountain is a large area of pre-Cambrian volcanic rocks, metamorphosed rhyolites and basalts. Red Triassic sediments occupy a small area near Lisburn.

In the old days limestone was taken from the outcrop by the pioneers, who seem to have had energy to spare, and used for building houses, churches and mills; substantial structures that would stand for cen-

turies. Some of these buildings are in use now and as strong as when new. Limestone was quarried and burned for building lime, for mortar and plaster, and the poorer burnt lime was sold for lining the soil.

Now the limestone quarries operating in Cumberland County are producing crushed limestone for concrete and for highways, and only a small proportion is saved out and sold for building stone.

This limestone is in beds from a few inches to several feet thick and dips south at different angles. In some places it is closely jointed and much fractured, and in other places it is so massive that large blocks can be taken. In color it is gray or blue but has several shades, as light, dark, bluish, and pearl gray, light and dark blue, brownish, pinkish, and mottled gray. The weathered surface generally is light gray, and practically all of the old limestone buildings are a warm light gray of very pleasing effect.

Exposures of this limestone are conspicuous as one enters the county from Harrisburg, both in the road cut at the railroad underpass in Lemoyne and along the railroad from Lemoyne south. Large quarries



Fig. 65. Detail of Grace M. E. Church, State Street, Harrisburg, built in 1871, showing durability of local limestone even in blocks laid with bedding vertical. Corner of buttress cap broken by lightning (?).

along the river and in Camp Hill now long abandoned were the source of building stone used in these towns and of some used in Harrisburg. For instance, the old quarry in Camp Hill at South 28th Street, an irregular pit about 200 by 300 feet across, contains stone that is an irregular wavy mixture of two kinds of limy mud. The darker material weathers more readily and leaves a rough light surface traced with irregular darker lines. Some of the limestone has prominent brown nodules that stick out $\frac{1}{2}$ to 2 inches as irregular rough, pitted lumps along the bedding. This quarry contains stone like that in Pine Street Presbyterian and Grace Methodist Episcopal churches in Harrisburg. Limestone has been quarried in recent years on the Gettysburg pike 1 mile east of Shiremanstown by Mike D'Angelo, but entirely for crushed stone, the demand being too brisk to permit bothering with sorting out blocks for building stone; and by Hempt Brothers at Eberly's Mill, 2 miles west of New Cumberland. This quarry, opened in 1925-26 on thin but rather regular beds dipping 28° , produces mostly crushed stone for all purposes; but they lay out both light and dark building stone. The dark stone is very fine-grained, almost black on fresh fracture, but it weathers light gray. The light stone is slightly pinkish gray and makes a pleasing house wall. Houses built of these different limestones were erected in 1928 on North Second Street, Harrisburg, between Radnor and Division Streets.

Limestone in other quarries throughout the county has been quarried for flux, as at Boiling Springs and Pine Grove Furnace, for crushed stone, and burned for building and agricultural lime, as at Bowmansdale, Mt. Holly Springs, Shippensburg, and Carlisle. Some of the beds in these quarries can furnish material suitable for building stone.

In Carlisle the old buildings at Dickinson College and the wall around the campus are of local limestone, as are also St. Paul's Lutheran Church and the Methodist Episcopal Church. This local stone weathers to light bluish gray but contains brown and tan irregular cherty bands along the bedding. It is quite durable, does not stain readily, and makes a satisfactory building stone. Henry Memorial Hall, Bosler Library, Denny and Conway Halls at Dickinson College are in part of dressed Hummelstown brownstone.

Several light gray stone buildings in Shippensburg are the local limestone, which outcrops on the Main Street near the west end of the borough.

A diabase dike that extends nearly due north from Boiling Springs to North Mountain makes a low ridge so stony as to be uncultivable. This physiographic feature, marked by a narrow line of trees, is a natural boundary between Silver Spring and Middlesex Townships, and between Monroe and South Middlesex Townships north of Yellow Breeches Creek. The dike is only a few rods wide but it is so much harder or more resistant to weathering than the limestone and shale through which it is intruded that it stands up as a low ridge. The weathered boulders that mark the outcrop are generally brown with the yellowish tinge of iron stain, and on fresh fracture nearly black. So far as observed this stone has been used here only for fences.

At West Fairview an abandoned sandstone quarry on the river bank has a face 200 feet long and 70 feet high in beds dipping S. E. 70° . They consist of fine-grained, platy, almost black sandstone, and more

massive sandstone that dresses to bluish-gray and weathers very dark. Some beds are gashed with calcite veins. Frequent irregular and curved joints limit the product of this quarry to rubble and crushed stone.

The Summerdale Quarries, so-called by a signboard, was a small crushed stone operation on the south slope of North Mountain above Enola, using Tuscarora sandstone float. No quarry was opened to supply the demand for "Summerdale" stone for building purposes. This stone includes coarse and fine-grained sandstone and grit, the latter carrying quartz pebbles up to $\frac{1}{2}$ inch in diameter. Color varies through cream and pink to reddish, some blocks being mottled or variegated, but all generally light colored. This stone is hard, dresses fairly well to rectangular blocks of good size, and makes a wall of pleasing appearance as evidenced by buildings in Enola, Wormleysburg, and Harrisburg. The Miller house and greenhouse on the mountain side above Enola are of this material. The weathered blocks on the surface in the woods were broken up to make these and other buildings. One builder says that this is particularly good building stone because, being weathered, it does not draw moisture and the houses are not damp.

DAUPHIN COUNTY.

The water gaps that mark the course of the Susquehenna through the mountains determine through-routes of travel. Dauphin County on the east bank of the river is the site of five water gaps and Harrisburg, the Capital of the State is the junction of railroads and highways extending in all directions. These highways include the William Penn and Lakes to Sea highways and Susquehanna Trail. With an area of 522 square miles and a population of 153,000, it has 293 people per square mile and is exceeded in density of population by only 8 other counties. Here, too, stone buildings are more numerous than in other counties. Early settlers laboriously built with their own hands and used the ready material, limestone in the Great Valley, brownstone in the red soil area, and gray sandstone along the mountains.

A map showing the stone houses throughout the county and the kind of stone in each would roughly outline the distribution of some of the rocks. At least, limestone masonry is almost confined to the valley underlain by that rock, and old brownstone buildings are commonest in Middletown.

The distribution of the geologic formations is in bands having an east-west or northeast trend. Red sandstone and shale of Triassic age occupy all the south end of the county below Highspire and Hummelstown. Here is found the well-known Hummelstown brownstone and trap rock or diabase, an igneous rock intruded in the Triassic sediments.

Through Steelton, Hummelstown and Hershey is a belt of Cambro-Ordovician limestone and dolomite. North of the limestone to the foot of Kittatinny Mountain is a broad belt of Ordovician rocks, known as the Martinsburg shales. This belt includes some hard, dark sandstone beds.

From Kittatinny Mountain to the northern boundary of the county at Mahantango Creek is a series of mountain ridges separated by wide valleys. The valleys are underlain by shales of Catskill and Mauch

Chunk age and the ridges are made of hard sandstone. First Mountain is Clinton, Tuscarora and Oneida sandstone, with sandstone of Hamilton age on the north side. Second, Peters, Berry, and Mahantango Mountains are Pocono sandstone, and the two fish tails of the southern Anthracite field in Third, Broad, Big Lick and Coal Mountains are Pottsville conglomerate.

Even the shale formations contain some sandstone members that are suitable for building purposes.

The following description will begin at the south end of the county and work north.

Brownstone.

The Triassic sediments in the southern end of the county contain beds of brown sandstone that in some places are sufficiently hard and massive to be a source of commercial building stone. This deep reddish-brown stone is known as brownstone and has been quarried near Hummelstown since 1800 or earlier. The only brownstone quarry operating in Dauphin County in recent years is that of the Hummelstown Brownstone Company at Waltonville, about 2 miles south of Hummelstown and 10 miles east of Harrisburg. It ceased quarrying in 1927 and the stone sawing and finishing was discontinued in 1929. The Berst house on the quarry property is built wholly of this stone and bears a tablet set in a gable bearing the owner's name and the date 1800. The adjoining barn also of brownstone was built in 1809. In a little enclosed cemetery along the highway near by are tombstones bearing dates earlier than 1725. Some of these old tombstones show little or no effect of weathering, and the stone in the Berst house and barn shows no sign of deterioration. From this early raising of slabs for tombstones and of thicker beds for building stone prior to 1800, the quarrying of brownstone in this locality grew until a number of large quarries and extensive stone dressing shops occupy an area of several hundred acres. In the height of production several hundred men were employed and 30 derricks were in operation. In recent years the number of men employed has been about 150. A private railroad with several miles of main line and sidings to the various quarries makes connection with the Reading System at Hummelstown.

The most desirable stone is even-grained, close textured, reddish-brown and occurs in layers 20 inches to 20 feet thick. Although bedding planes are not conspicuous the stone cleaves easily parallel to the bedding. The beds dip N. 40°. Joints are few and not regular. Good stone occurs at several horizons, but one band about 50 feet thick has borne the brunt of the quarrying, and been opened for more than half a mile along the outcrop. Of other beds that have been quarried, but much less extensively, is one yielding purplish-brown stone and others in which the texture is coarser or the sand contains quartz or shale pebbles.

It was the production and shipment of stone from this locality for enlarging the locks of the Union Canal, Reading to Middletown, 1853-58 and for bridges and culverts on the Lebanon Valley Railroad, that first brought this stone to the attention of other than local contractors. One of the first buildings in which it was much used was the Dauphin County Court House at Harrisburg, built in 1860. The stone in this brick building includes six large columns and portico, steps, broad platform, and trim. Some of the stone is conspicuously conglomeratic,

with abundant quartz pebbles up to the size of a hickory nut, but most of it is even-grained sandstone. The building exhibits the effect of city atmosphere in 70 years on these two kinds of stone. The sandstone is generally in fair condition but the conglomerate is more or less pitted where pebbles have weathered out of the sandy matrix. I have heard it said that the conglomerate in the large columns in the Court House came from Yellow Breeches Creek which forms part of the boundary between Cumberland and York Counties, but think this statement may be questioned. The brownstone front of the Court house was cleaned by sand blast in January 1929.

Market Square Presbyterian Church in Harrisburg is trimmed with brownstone and the Harris Street Evangelical Church (1910) is Hummelstown brownstone. There are many examples of the use of this stone in Harrisburg and Hummelstown, most of which speak well for its durability when properly selected and placed.

Since 1867 the quarry property has been largely owned and operated by the Walton family, and Allen Walton developed in 20 years a trade that extended to Florida and St. Louis, Mo.; and included buildings in Washington, Baltimore, and New York and many in Philadelphia, Harrisburg, Reading, Lancaster and other eastern cities.

Notable buildings wholly or in part of Hummelstown brownstone and not in Pennsylvania are as follows:

District of Columbia

Washington—Cochran Hotel, Wyatt Building, Home Savings Bank, United Bretheran Church (N. Capitol Street), St. Joseph's Roman Catholic Church.

Florida

Deland, Stetson University; Orlando, Court House; Tampa, Y. M. C. A.

Indiana

Indianapolis, Union Station.

Kentucky

Lexington, Second National Bank.

Maryland

Baltimore, National Exchange Bank, Hampden School; Cumberland, Third National Bank; Rockville, Court House; Taneytown, Lutheran Church.

North Carolina

Wilmington, Heyer Building; Wilson, Branch Banking Co.

New Jersey

Atlantic City, Neptune Hose Co. Bldg., St. James' Episcopal Church; Gloucester, High School; Haddenfield, High School; Phillipsburg, High School; Orange, Methodist Episcopal Church; Pitman, High School; Secaucus, Public School; Shrewsbury, Public School; Trenton, Roebling Office Building, Park Avenue and Clockner Schools.

New York

Buffalo, Corpus Christi Church; Clifton Springs, Sanitarium; Elmira, German Evangelical Church, Elmira Nat'l. Bank; New York, Market and Fulton National Bank; Watertown, First Universalist Church.

Ohio

Cleveland, Areade Building, Windemere M. E. Church; Niles, Methodist Episcopal Church; Salem, Pennsylvania Railroad Station.

Virginia

Abingdon, U. S. Court House and Post Office; Danville, Opera House; Richmond, Residences 819, 824, 906, 921, 924, 926, 928, 930, 1000, 1014, 1020 West Franklin Street; Tazewell, Bank of Clinch Valley; Winchester, Union Steam Fire Company House.

West Virginia

Bluefield, Peoples Bank; Clarksburg, Methodist Episcopal Church, Empire National Bank; Mannington, Presbyterian Church; Phillipi, Barbour County Court House; Piedmont, First National Bank.

Pennsylvania.

In Pennsylvania the buildings in which brownstone from the Hummelstown quarries is the main structural material or trimming are so numerous that all will not be mentioned.

Allentown	Eleven public school buildings, St. Luke's Lutheran Church, Sacred Heart R. C. Church
Altoona	First M. E. and Simpson M. E. Churches, First Reformed Church, High School, Central Trust Company
Beaver	United Presbyterian Church
Beaver Falls	Federal Title & Trust Co.
Bethlehem	John Fritz Memorial Church, Holy Ghost R. C. Church, Bethlehem Trust Company
Bloomsburg	Court House, Presbyterian Church
Brookville	Presbyterian Church
Butler	High School, Methodist Episcopal Church
Carlisle	Bosler, Conway and Denny Halls, Dickinson College, Y. M. C. A., St. Paul's Lutheran Church
Chambersburg	Valley National Bank, Cumberland Valley Railway Station.
Clearfield	County National Bank
Columbia	St. Peter's R. C. Church, Cookman M. E. Church
Conshohocken	First M. E. Church
Delta	First National Bank
Du Bois	National Bank

Emporium	County Court House, High School
Erie	St. Ann's R. C. Church
Gettysburg	Citizens Trust Company, Pennsylvania College, Lutheran Theological Seminary
Greenville	B. & L. E. R. R. Station
Hanover	Peoples Bank, Roman Catholic Church
Harrisburg	Governor's Mansion, P. R. R. Station, Senate Hotel, Pa. State Hospital, Donaldson Apartment, Stevens Memorial Church, Foose, Cameron, Camp Curtin, Lincoln and Vernon schools.
Hazleton	Y. M. C. A., M. E. Church
Homestead	Presbyterian and Baptist Churches
Huntingdon	Reformatory, Blair Building, Union Nat'l. Bank
Indiana	Presbyterian Church, County Home, B. P. O. Elks Building
Johnstown	Roman Catholic and First Christian Churches
Kane	M. E. Church
Kutztown	Kutztown National Bank
Lancaster	Stevens High School, Grace Lutheran Church
Latrobe	Citizens Realty Company Building
Leechburg	Lutheran Church
Lewisburg	Christ Lutheran Church, Reformed Church
Lewistown	Mifflin County Nat'l. Bank, St. John's Lutheran Church
Loek Haven	Roman Catholic Church, Hospital, State Teachers College
Mansfield	State Teachers College
Meadville	Baptist Church
McKeesport	Baptist Church
Millersville	State Teachers College science hall, library and gymnasium
Milton	M. E. Church, residences of F. H. Godcharles, C. H. Diekerman and G. S. Shimer
Mount Holly Springs	Library
Mt. Carmel	Fagley Building, First Presbyterian Church
Muney	Lutheran Church
New Bloomfield	Perry County Prison
Oil City	Lutheran Good Hope Church
Philadelphia	Bullitt Bldg., Fourth Street Nat'l. Bank, Northwestern Nat'l. Bank, North American Bldg.
Pittsburgh	Emory M. E. Church, Third United Presbyterian Church, First Presbyterian Church
Pittston	Y. M. C. A.
Pottsville	Post Office, Garfield School, Park Hotel
Punxsntawney	High School, Baptist Church

Reading	First Baptist Church, R. C. Convent of the Good Shepherd
Renovo	Lutheran Church
Reynoldsville	M. E. Church, Peoples Nat'l. Bank
Ridgway	M. E. Church, National Bank
Scotland	Soldiers' Orphan Industrial School
Seranton	Public School No. 36, Moses Taylor Hospital
Shamokin	Guarantee Trust Co., Congregational Church, Miners Hospital
Shippensburg	High School
Spring Grove	Reformed Church, Lutheran Church
Steelton	High School, St. John's Lutheran Church
Sunbury	High School, County Prison, Masonic Temple
Tamaqua	High School, Hotel Moyer
Tionesta	M. E. Church
Towanda	Roman Catholic Parochial School
Tyrone	Lutheran Church
Warren	Savings Bank
Waynesburg	M. E. Church, Peoples Nat'l Bank
Wellsboro	M. E. Church
Wilkes-Barre	City Hall, Y. M. C. A., Hotel Hart
Williamsport	Trust & Safe Deposit Co., Hospital, B. P. O. Elks Building, Temple A. A. S. Rite, Episcopal Church
York	Noell School, Colonial Hotel, Royal Engine House, Collegiate Institute

A quarry on the railroad $1\frac{1}{2}$ miles N. E. of Middletown was once well equipped with large steam derricks, saw gangs, etc. and must have shipped considerable stone but it has not been operated in the last 35 years. It may have been the source of some of the brownstone buildings in Middletown, the oldest of which are Saint Peters Kierch built in 1767 and the old mansion house of the Frey estate built in 1768. Both of these are of brownstone laid in regular courses and are still in use. The stone appears to be in good condition except the base courses of the house. These have spalled near the ground but not enough to endanger the building. The front and side walls of the Frey house are strongly contrasted, the stone in the front elevation being squared and dressed smooth, and that in the rest of the house irregular rough blocks.

Trap Rock.

Trap rock or diabase, a dark-colored, usually fine-grained igneous rock intruded in the red Triassic sediments, occurs abundantly in Londonderry Township from Roundtop to Swatara Hill and thence, to the river just below Royalton and to the Pennsylvania Railroad bridge over Conewago Creek. At the west end of this bridge is a quarry that, when operating, was equipped with a Corliss steam engine, steel derrick booms, crushers, and a steam shovel. It has been idle since about 1917. Much rock near the surface is so deeply weathered as to be valueless, and irregular and close joints would make the raising of large blocks



Fig. 66. Frey estate mansion house (1768) Middletown, Dauphin County. Triassic brownstone coursed ashlar front and rubble ends.



Fig. 67. Deterioration of brownstone in foundation of Frey mansion house, Middletown.

impossible except from the lower part of the quarry. It was flooded when last seen.

Trap residual boulders are abundant on Swatara Hill east of Middletown and have been broken for rough foundations. Although very durable this stone is so dark as to make it unattractive for whole buildings.

The monument to Civil War veterans at Second and State Streets, Harrisburg, is trap rock. It stood for some years incomplete. I have



Fig. 68. Soldiers Monument, Harrisburg, built of trap rock.

not learned the source of the blocks in the lower half of the monument but the upper courses and cap stone are reported to have been made from surface blocks taken between Goldsboro and Cly. Some of the blocks show scaling to a depth of one-eighth inch. Trap rock in this monument and in the foundation of Pine Street Presbyterian Church shows surface deterioration by scaling after 70 years, but not enough to require replacement, the scales being only one-eighth inch thick. Trap was used also in the wall of the Civic Club at Front and North Streets, Harrisburg.

Limestone.

The broad belt of limestone making the Great Valley from Easton through Allentown, Reading, and Lebanon is only 3 miles wide at

Hershey and barely a mile wide where it reaches the Susquehanna below Steelton. A similar narrow belt extends from South Harrisburg to Rutherford.

Many quarries have been opened in this limestone. d'Invilliers¹ described 32 in Dauphin County, most of which were operated for flux and lime. The beds vary up to 4 feet thick, and in some places are suitable for building stone. Forty years ago limestone for building sold for 55 cents a perch; large stones for \$1.00 a perch. Those were in the days when quarry laborers were paid 12 cents an hour. In 1931 limestone for building sold for \$1.50-\$2.75 per ton at Harrisburg, and higher prices are obtained for selected stone of even thickness and color. Quarry laborers received 40-50 cents per hour.

In the 40 years that have elapsed since d'Invilliers listed the quarries, others have been opened and are regular producers. The larger operations are: Bethlehem Steel Company, Steelton; Hoffman Brothers and Wilson, Harrisburg; and H. E. Millard, Swatara. The last two are producing crushed limestone for concrete and for road metal, and the Steelton quarry is operated mainly for flux. This quarry has



Fig. 69. Pine Street Presbyterian Church, Harrisburg. Built in 1859 of local limestone, trimmed with trap.

¹ d'Invilliers, E. V. Iron ore mines and limestone quarries of the Cumberland-Lebanon Valley: Pa. Second Geol. Survey, Ann. Rept. 1886, Pt. IV, pp. 1523-38, 1887.

a face more than a quarter of a mile long and about 100 feet high, and brings down 100,000 tons of stone at a blast. Rough building stone could be produced at these quarries. The bedding is nearly flat, varies in thickness, and the joints are not too close to permit taking building blocks.

Buildings of local limestone are common in Harrisburg and vicinity. One of the oldest stone buildings in the county is Paxtang Presbyterian Church which is said to be the oldest Presbyterian Church in the entire State. It is a one-story structure in Paxtang Boro just east of Harris-



Fig. 70. Presbyterian Church, Paxtang, Dauphin County. Built in 1740 of local limestone.



Fig. 71. Bailey residence, 401 North Front Street, Harrisburg; formerly Harrisburg Academy. Built about 1791 of local limestone.



Fig. 72. First Church of Christ Scientist, Front and Woodbine Streets, Harrisburg, built of limestone from Hershey, Dauphin County.

burg. It was built in 1740 of local limestone, which weathers to an even gray and is in good condition after 190 years. The Harris Mansion house built of limestone in 1766 by John Harris, Jr. and standing at 219 South Front Street, is the oldest residence in the city. Mr. Richard C. Haldeman, the present owner, has made some alteration to this old house, but in the main the limestone walls are as originally laid. The Bailey house at 401 North Front Street, Harrisburg, formerly the residence of Senator William Maclay and occupied once by the Seiler (later Harrisburg) Academy was erected about 1791; Pine Street Presbyterian Church (1859); and Grace M. E. Church (1871), are examples of older buildings. Since 1920 many limestone houses have been built on North Second Street between Seneca and Division Streets. The Christian Science Church at Front and Woodbine streets, built in 1926 is a good exhibit of selected gray limestone from a quarry on Spring Creek by the golf course at Hershey. Other colors to be had from local quarries are dark blue, dove, and slightly pink.

Churches in Hummelstown and part of the Hershey Chocolate Company plant at Hershey are the local gray limestone. The Reinhard Lime Works near Swatara produces limestone rubble for building.

In Harrisburg on Second Street between Wiconisco Street and Polyclinic Avenue are several houses of dark limestone from Hempt Brothers' quarry at Eberlys Mills near New Cumberland, and of light limestone from Hershey. Other examples of dark limestone from Eberlys Mills are the retaining walls along the main highway in Penbrook and Progress.

Sandstone.

In the belt of Martinsburg shale 7 miles wide occupying the lowland south of Kittatinny Mountain are hard, dark sandy beds that have yielded rubble for foundations and for an occasional farm house and barn. These sandstones may be very dense and quartzitic, or slightly porous. Commonly they weather to a greenish hue but some are almost

black and very hard. The house of Ray Snow 8 miles east of Harrisburg on the Jonestown road at the crossing of Beaver Creek appears to be of this kind of stone derived from the demolition of a mill. A date stone indicates original construction in 1766. The stone is thoroughly durable but poor color.

The Tuscarora and Juniata sandstone (Medina) in Kittatinny Mountain are massive gray rocks that make much float and have been used for stone walls, rough foundations and an occasional farm house along the slope.

The only operating quarry in Dauphin County north of Harrisburg is in Hamilton sandstone at Rockville at the river end of the spur of Kittatinny Mountain. It is operated by The Rockville Quarries Company, formerly by Robert McCreath & Company, Harrisburg. Here the rocks stand on edge and have been quarried for about 400 feet across the bedding, which varies in thickness from almost shaly to massive. The rock is very hard and is crushed at the rate of several hundred tons a day. Rough building stone and small flags may be had on demand. The stone is fine-grained, dense, of varying shades but mostly greenish gray. Some blocks stain with iron after a few years exposure. Stone from this quarry was used in Harrisburg in the H. F. Gross residence, 3300 N. Second Street, store at 3200 N. Second St., residence at 2902 N. Second Street, C. C. Sampson residence on River Road, and next house.

Another source of sandstone for building is on Kittatinny Mountain near Picketown or Heckert Gap, which is north of Linglestown. Here an abundance of heavy float from Median (?) sandstone has furnished material for a number of buildings in Harrisburg. A notable example is the Olivet Presbyterian Church (1929) on Derry Street near 14th Street, Harrisburg. The random ashlar ranges between long slim blocks and square ones, up to blocks 8 to 10 inches thick and 30 inches long. The fresh stone has a pink tone, varying to tan and reddish with occasional rusty spots. It is a medium-grain sandstone with rare quartz pebbles, and highly siliceous.

A sandstone that offers attractive possibilities as a building stone and outcrops extensively in the northern part of the county is the Pocono sandstone. It forms the backbone of Second, Peters, Berry, and Mahantango Mountains, and makes such large and abundant float blocks that as yet they supply the building stone. It is a medium-grained silica sand, occasionally with small quartz pebbles, and so thoroughly cemented with silica that it is hard to dress. The freshly broken stone has a light tan to pink color which will remain unchanged for many years. It is this very pleasing color that makes the stone particularly attractive. One of the old stone houses in Dauphin County is Edgewood, the C. W. Lynch house at the south base of Peters Mountain 4 miles east of Susquehanna River. This large house was built in 1720 of blocks made by breaking up Pocono float on the mountain side, and to this day shows variegated purple, red, tan, straw, and gray colors. In recent years large blocks along and above the road over the mountain have been broken up and hauled to Harrisburg for several fine residences along the river and elsewhere in the city. One of these is the home of Charles C. Stroh, 2921 North Front Street, which exhibits well the pleasing character of this stone.

As the sandstone on the south side of Peters Mountain dips south

60°, a quarry half way up the mountain would have the bedding in good position for working. As some layers carry quartz pebbles $\frac{1}{2}$ inch in diameter care should be taken in selecting the site if these are to be avoided.

Pocono sandstone from Cove Mountain at Perdix, in Perry County, was used for building Otterbein U. B. Church (1928) at Logan and Pepper Streets, Harrisburg. The random ashlar ranges between 10 by 10 and 5 by 14 inches, with occasional smaller blocks. The stone is gray to pink, with some reddish and rusty, and makes attractive masonry.

The only quarry I have observed in the Pocono sandstone is beside the river road at the end of Berry Mountain one mile south of Millersburg. Catskill red shale and sandstone standing nearly vertical are exposed for several hundred feet in the road cut, with the Pocono at the north end. The quarry is merely a small recession of the road cut, made possibly to get material for some near by bridge or foundation walls, for I saw no stone buildings in Millersburg.

In Elizabethtown on the south side of the highway are two stone houses, built by John Paul probably 100 years ago. One house has a round front. All the stone came from Pocono float on the adjacent mountain side. The blocks were dressed square but the finished surface is roughly pitted by uneven fracturing. The blocks range up to 12 by 18 and 10 by 40 inches. After a century the stone still shows red and rose color and the general tone is described as beige.

The street curbing in Elizabethtown is conglomerate, probably Pocono float. The foundations of three churches in Elizabethtown and two barns west of the village are very neat dressed gray sandstone from the same source.



Fig. 73. Pottsville sandstone in Roman Catholic Church at Williamstown, Dauphin County.

East of Loyaltown and near Lykens where the highway is along the foot of Short Mountain one sees long walls on the north side of the road built of Pottsville conglomerate, in which the white quartz pebbles are larger and more abundant than in the Pocono. The Roman Catholic Church in Williamstown was built in 1922 of Pottsville conglomerate float from the mountain side right above town. The conglomerate dresses well to rock face and the fresh faces show a pretty blend of tan, rose, and gray all in the same block. Some blocks are a mass of $\frac{1}{8}$ - $\frac{1}{4}$ inch quartz pebbles, and some are clean sand. The blocks in the church are 4 to 10 inches thick and up to 30 inches long. This church is a demonstration of the excellent stone work that can be done with Pottsville conglomerate.

Red sandstone in the Catskill and Mauch Chunk formations has been used in rural buildings where that was the handiest stone. On the bank of Powell Creek by the covered bridge south of Powell Valley is an old farm house built of red Catskill sandstone in slabs 2 to 6 inches thick. At the back door are two flags measuring 3 or 4 by 6 or 7 feet. The front yard is held up by a wall of large dressed blocks of grey conglomerate, laid without mortar, and probably from the Pocono in Peters Mountain. All this stone work appears to be in good condition, and shows the possibility of making a substantial building of slabby sandstone. Some foundations in Powell Valley are of the same red sandstone. The foundation of a mill on Wiconisco Creek 3 miles east of Elizabethville is of red Mauch Chunk sandstone which outcrops in the road near by.

Prominent stone buildings in Harrisburg.

It may be of interest to some readers to record here the principal stone used in some of the larger buildings and other structures in the State Capital.

The main capitol building is granite from Hardwick, Vermont; the long balustrade fronting the plaza and the broad flight of stairs leading to Third Street are granite from Chelmsford, Mass.

Indiana limestone is the facing stone of three large new buildings in the capitol group, the North and South Office Buildings, and the Education Building, also of the State Library and Museum (1894). Soldiers and Sailors Memorial Bridge (1930), Bell Telephone Building, and Zimbo Temple.

The Roman Catholic Cathedral on State Street is Port Deposit (Md.) gneiss.

The Market Street bridge over the east channel of the Susquehanna River is sandstone from Curwensville, Clearfield County, and Koppel, Beaver County, topped with Indiana limestone.

The Roman Catholic Church (1930) at Third and Woodbine Streets, Arthur H. Hull's house at 2909 North Front St., Ralph J. Baker house at North Front and Wiconisco Sts., and a church at Front and State Sts., are mica schist from the Philadelphia district.

A white marble residence at 2601 N. Front St., Harrisburg, owned by J. W. DeChant is built of stone from the farm of S. Forry Laucks 2 miles north of York. The church of the United Brethren in Christ at 15th and Derry Sts., built in 1906, is marble that looks like the Chester County stone.

DELAWARE COUNTY.

Delaware County, in the southeast corner of the State, bordering on the river and State of the same name, is smaller than any county except Philadelphia. It has a denser population, however, 935 per square mile, than any other county except Allegheny and Philadelphia. It was named for Lord de la Warr, governor of Virginia.

Media is the county seat. Chester city has one-third the population of the county. Although the western part of the county is farm land and suburban estates, as a whole rather sparsely settled, the belt along the river from Lansdowne and Darby to Marcus Hook, a distance of 12 miles, is almost continuously built up. These communities close to Philadelphia have developed rapidly since 1920 and the number of stone houses is strikingly large. Most of the stone is of local origin, although Indiana limestone, Port Deposit gneiss, and Tennessee marble have been used.

Delaware County is abundantly supplied with building stone and many quarries have been opened. The igneous rocks are granite gneiss, hornblende gneiss, gabbro, and serpentine, and the sedimentary rocks are Baltimore gneiss and Wissahickon gneiss. Large areas are underlain by gabbro, Wissahickon gneiss and granite gneiss. Other rocks are less abundant though they may be widely distributed in small patches. Gabbro occupies a large part of Edgemont, Bethel, and Upper Chichester Townships; Wissahickon gneiss occurs from Cooperstown to Broomall, through Media, Marple, Swarthmore, and Village Green; granite gneiss is the country rock in Clifton Heights, Morton, Rutledge, Avondale, Ridley Park, and south from Field's quarry at Lima to Glen Riddle.

An area of serpentine lies north of Crozierville around Lima and Black Horse, and also from Worrell northward. Central Square, Newtown Square, and Edgemont are on Baltimore gneiss.

Some of the quarry operations in this county are for crushed stone only, some for building stone as well as crushed stone, and some are for building stone only. The latter are worked less regularly than the others. Quarries active when this is written may be abandoned when it is published, or greatly enlarged. Much of the quarrying is done by Italians. The following descriptions may therefore be out of date as to size and ownership.

Wayne. In a distance of half a mile just east of Wayne one finds Octoraro schist, Wissahickon gneiss, Baltimore gneiss, serpentine, and gabbro. The Philadelphia folio (U. S. G. S.) shows a quarry in the serpentine at St. Davids and in Baltimore gneiss half a mile east of Radnor Station, but in this neighborhood the only quarry worked recently is that of William McClellan, of Wayne. This quarry, in Baltimore gneiss, is south of the golf course at St. Davids, $\frac{1}{2}$ mile northeast of Five Points or Ithan, behind the filtration plant. The rock in this quarry is mostly very dark and shows little banding; but much stone is banded, and some light-colored rock has noticeable blue quartz and garnet. The banding pitches about 15° and jointing is mostly vertical. Joints are closely spaced in some parts of the quarry, and elsewhere 3 to 4 feet apart. They decrease with depth and the rock in the lower part of the quarry is rather massive. Most of the output is crushed for local contractors but building stone is sold also. This



Fig. 74. Baltimore gneiss quarry, northeast of Ithan, Delaware County.

rubble may be very dark, almost black, and homogeneous, or it may be lighter and banded. About 20 men were employed around the quarry and crusher in 1927.

According to the Annual Report of the Second Geological Survey for 1886 (part IV, page 1580), the largest quarry in this part of Radnor Township at that time was on the old Lancaster road close to Wayne Avenue half a mile southwest of Wayne. "This was opened for bridge and culvert stone, for the widening and straightening of the Pennsylvania Railroad, about 1880, and blocks with straight fracture and of many tons weight were abundantly obtained." This location is shown on the geologic map in the Philadelphia folio as being underlain by gabbro.

The Second Survey reports in the same volume (p. 1577) that "the rectory of the Church of the Good Shepherd, on the Lancaster pike half a mile northwest of Rosemont, was built of reddish feldspathic granite quarried on the land of Jos. F. Tobias, 1800 feet W. S. W of Rosemont."

Broomall. Three quarries on the south bank of Darby Creek one mile north of Broomall are producing mica schist for building stone. All are served by a branch of the Pennsylvania Railroad.

The Foxcroft quarry, formerly operated by the Foxcroft Stone Company of Philadelphia, and in 1927 by D. L. Sloan of Upper Darby was opened about 30 years ago and now has a face 400 feet long and 100 feet high. The schistosity is vertical and in some places is contorted. Twenty men are employed. Compressed air drills are used, and the rock is shot down haphazard. The stone produced is for rough construction, the pieces are one-man size, are loaded by hand in a dump cart, hauled by horse to a platform and dumped directly into railroad

cars. The superintendent cited as buildings in Philadelphia in which this stone was used: the school at 51st. and Master Streets, a church at 11th and Rockland Streets, and a bank on Baltimore Avenue near 58th Street. The rock ranges from massive quartzose gneiss through rock with mica bands every quarter inch to coarse dark mica schist. The broken stone is sorted into four kinds, hard blue stone and mica schist for facing stone, foundation stone and backing and rough flags.

R. W. McConnell, 4506 Regent Street, Philadelphia, operates the Stuart Wood quarry, of the Foxcroft Stone Company, which is about a quarter of a mile down the creek. It was opened in 1914 for rough building stone and now is a nearly circular opening 100 feet in diameter with a face 75 feet high on one side. The formation appears more massive than at the Foxcroft quarry and produces a good grade of mica schist. A gasoline motor compresses air for the drills and a steam winch pulls small tram cars out of the quarry to a platform from which the rock can be dumped into railroad cars. In July 1927, 10 men and one horse were employed at the quarry and the output was going mostly to Philadelphia for building stone. Some is blue, some gray, and some weathered brown. Gray stone from this quarry was used in the Memorial Building, West Chester State Teachers College and in Goodhart Hall, Bryn Mawr College, built in 1927. Single stones 8 to 10 feet long are used for window lintels and sills.

W. A. Hayden, who formerly operated a quarry at Gladwyne, opened one at Broomall in 1925. It is on the creek bank east of the bridge and adjoins the McConnell quarry, being separated from it only by the railroad. The rift is about vertical and the rock is blasted down in big irregular blocks which are manded into rough building stone much



Fig. 75. Wissahickon gneiss in Hayden quarry, Foxcroft, near Broomall, Delaware County.

like that produced at the Sloan quarry. Some of the rock tends to break into long blocks like posts. Stone from this quarry was used in the Home for Incurables, Belmont and Conshohocken Avenue, West Philadelphia, and in the recent addition to Notre Dame College. In

July 1927 about 25 men were employed, and a gasoline motor produced compressed air for operating the drills.

On Langford Run just south of Broomall a quarry was opened in 1925 and in 1927 was operated by Donato Di Tomasso, contractor, 219 North 65th Street, Philadelphia. It is in the Wissahickon formation, here a mica schist with a few aplite veins parallel to the schistosity and ranging from a few inches to two feet thick. The stone is mostly gray, very sandy mica schist but includes some coarse-grained phases. In 1927 ten men were employed and the product was mostly for foundations. It was used in apartments and houses in Narberth, Ardmore, Overbrook, and 57th Street and City line.

The rock in these four quarries is a phase of the Wissahickon formation. The specimen in hand is a very thinly laminated, closely folded, highly micaceous gneiss or schist. To one unfamiliar with this kind of stone it would not seem sufficiently durable for building, but it has proved eminently satisfactory.

Media. Stone buildings are common in Media and some of them have been standing more than a century. Quarry sites are readily available, the stone is easily worked, and is durable. The quarrying of building stone therefore has long continued in this vicinity. With the growth of Philadelphia and the utilization of some of its urban quarry sites for other purposes, the demand for stone has resulted in quarries being opened farther from the city. New quarries were opened near Media in 1924 to supply the demand from the city. Both quarrymen and their product were transported between the city and quarry by automobile truck.

J. W. Hibberd has operated a quarry in the Wissahickon gneiss on the road to the Springfield Water Company plant $\frac{3}{4}$ mile east of



Fig. 76. Clothier Memorial Hall, Swarthmore, Delaware County. Mica gneiss from Hibbard quarry, Media. Ridgway flagstone walk. Photo by Bond Bros., Philadelphia.

Media near the top of the steep bank of Crum Creek for a number of years. A recent notable example of the use of this stone is Worth Hall, Swarthmore College. See Fig. 76. Three fraternity houses at Swarthmore also were built of stone from this quarry. The stone is a mica gneiss in distinct wavy lamellae $1/16$ to $1/8$ inch thick. Mica is so abundant on the bedding planes as to mask the other minerals. A section across the schistosity shows that the rock is composed of layers of quartz and feldspar separated by paper-thin partings of mica. The rock breaks with irregular surfaces but dresses to a good building stone and its glistening silvery faces lend attraction.

Marple. Buttee & Orlando operate a quarry on Holland Run 2 miles northeast of Media and $1/2$ mile west of Marple. This small quarry was opened by J. Skelly, Media, about 1920 and measured about 25 by 50 feet in November, 1924. In 1931 the quarry face was 300 feet long and 25 feet high. The product is rough stock for cellar and house walls and is hauled by automobile truck to Philadelphia. The quarry face is closely jointed vertically and contains bands of closely contorted mica schist. The rock is Wissahickon gneiss; some is light bluish gray and very sandy, and some is a silvery schistose gneiss. Sills and posts up to 8 feet long are made here.

In May, 1924, a quarry was opened $3/4$ mile southwest of Marple on a branch of Holland Run by Paolucci Camillo and J. A. Juliano. (address 214 N. 62nd Street, West Philadelphia) to supply rough building stone for their construction work in that city. From 5 to 7 men were employed without machinery and in the fall were producing several truckloads of stone daily. The stone is a highly micaceous Wissahickon gneiss.

At the mouth of Whetstone Run (Eagle Road) on Darby Creek, 4 miles northeast of Media, Vincenzo Di Francesco, (Llenerch P. O.) is quarrying gneiss and delivering crushed stone to Philadelphia customers by automobile truck. The quarry in 1924 was 125 feet long with a face up to 45 feet high. Twenty-five to 30 men are employed at the quarry, air drills are used, and electric power is used for crushing. The crusher plant was designed by the Good Roads Machinery Company, Inc., Kemmett Square, Pa. The primary crusher is a No. 6 and the secondary No. 4 Champion rock crusher. The rock is a finely laminated mica gneiss, showing both straight and contorted bands in the same hand specimen. It is hard, and good building stone can be produced on demand. Stone from this quarry was used in 1931 for facing the Crum Creek dam.

On the State road $1/2$ mile east of Marple and opposite the Rolling Green Golf Club is the Clearview quarry opened by Joseph McVaugh of Media, in 1917 for building stone. In 1931 it was about 70 feet wide, 20 to 30 feet deep, and advancing into the hill. It was then operated by Raffael Crispo. The stone is light gray fine-grained granite-gneiss on one side of the quarry, grading into augen gneiss that breaks fairly straight, and on the opposite side of the quarry a coarse augen gneiss that breaks irregularly. The coarse grained rock has light colored feldspar crystals up to one inch long embedded in a dark wavy matrix of quartz, biotite, and hornblende. The output of the quarry in November 1924 was going to the high school on School Lane and Lansdowne Avenue, Upper Darby. Many houses in Drexel Hill and Lansdowne have been built of this stone, and 70 on 63d Street, Philadelphia.



Fig. 77. Upper Darby High School, Lansdowne, Delaware County, built of Wissahickon gneiss from McVaugh quarry, Media.

The gneissic structure is vertical and the floor shows little jointing. Blocks have been taken up to 8 feet long. The quarry spalls are crushed for road metal and concrete aggregate, and the fines from the crusher are screened out for building sand. A steam tractor was used for driving a Champion No. 3 crusher, and a gasoline engine was being installed to operate an air compressor for drilling. About 15 men are employed. The output is delivered by truck.



Fig. 78. Doorsteps at C. I. Leiper residence on Crum Creek, near Swarthmore, built of gneiss in 1785.

Swarthmore. The largest quarries near Swarthmore are those of Callender I. Leiper where Sproul Boulevard crosses Crum Creek one mile south of Swarthmore. The large abandoned quarry south of the bridge was opened in 1785 and supplied stone for the owner's house a few hundred yards above the bridge. This house built in 1785 is in fine condition and still occupied by the Leiper family. The long pillars supporting the side veranda are notable, and the stone steps leading to the front door show how resistant this stone is to abrasion.

The upper quarry, which is worked intermittently, was opened in 1808. It is 1200 feet long, 100 to 150 feet wide, and 50 to 100 feet deep. The stone is granite-gneiss with vertical schistosity and horizontal joints. These joints 3 to 5 feet apart aid greatly in lifting the stone. The gneiss varies in tone, some being light, some dark, and some mottled with segregations of coarse glassy quartz. Veins of giant granite or pegmatite cut the gneiss and in some places garnet is common. The rock close to the surface is more closely jointed and has practically no cover.



Fig. 79. Granite gneiss quarry of Callender I. Leiper, Swarthmore, Delaware County.

Five derricks on the brink of the quarry and a pump are operated by electric motors. All delivery is by truck.

The use of the stone from the Leiper quarry is shown in most of the buildings of Swarthmore College and preparatory school, Presbyterian Church and Sunday School at Swarthmore, and the First National Bank at Media. In 1930 the John Wetherill public school in Chester was built of stone from this quarry, and in 1931 the new county jail near Media. Some of the recent output has been curbstone up to 12 feet long.

The largest eurbstone produced from this quarry is 37½ feet long. It is in the north eurb in front of a large house at 4th and Madison streets in Chester.



Fig. 80. Gneiss from Leiper quarry, Swarthmore, in John Wetherill school (1930), Chester.

A quarry opened about 1925 by Mr. Leiper at the north end of the Crum Creek bridge is producing rough stone for cellar walls. This gneiss close to the surface is not so hard or massive as that at depth in the adjacent large quarry.

Lima. Near Lima on the east bank of Chrome Run 2 miles west of Media a quarry in granite-gneiss was opened by B. Fields about 1910. This quarry, which is on the Baltimore Pike, was operated by Tom Fields in 1924 and by Angelo Nesci in 1927. The rock is a medium grained granite-gneiss ranging in color from slightly pink to bluish. A few coarse pegmatite veins up to 2 inches wide can be found. Near the surface the rock along some joints is deeply weathered to pink. The curved face of the quarry in which good stone is exposed is about 150 feet long and 20 feet high. Jointing is rather close and the gneissic structure is vertical. Rough building stone is the main product; slabs with smooth surface find a good market for garden walks and bring a good price.

Chester. On the east bank of Ridley Creek in the city of Chester quarrying has been carried on for many years, and a quarry face about 600 feet long has been developed. It was operated by the Baker Construction Company. The line between the Leiper and Deschone estates passes through the quarry which, however, is worked as a unit. The rock is granite-gneiss but different parts of the quarry yield distinctly different types. One variety, which the operator says is in considerable demand, he calls cadet gray sandstone. It is a soft, gray, finely granular mica-gneiss that breaks out in flat faced blocks but is very friable when freshly quarried. It is said to harden on exposure and to be a satisfactory and pleasing building stone. One would scarcely credit this statement on seeing the stone in the quarry. The rock is composed mostly of quartz with a thin sprinkling of minute mica flakes, and almost devoid of feldspar. The gneissoid structure is barely discernable.

Another variety of rock is distinctly gneissoid, glitters with small

white mica flakes, and has a yellowish tinge produced by partly decomposed feldspars. This rock is the hardest in the quarry and is well adapted to rough construction. A third variety is a very dark mica gneiss, some bands of which are very thinly laminated and composed so exclusively of mica that they might well be called mica schist. This rock breaks with fairly smooth surfaces along the plane of schistosity. These planes are silvery-gray to black, varying with the angle of reflection of bright light.

These light and dark gneisses run in bands and are cut by at least one vein of granite-gneiss or pegmatite. This pegmatite is composed of dull white feldspar mixed with mica crystals up to one inch in diameter, and a minor quantity of quartz. A band of black schist marks a close fold in the closed end of the quarry. Throughout the quarry the dip of the schistosity is west at a high angle. These rocks have the appearance of metamorphosed sediments.

The rock is quarried with compressed air and steam drills, and 10 to 12 men are employed. The output is sold for dimension and facing stone and for rough walls, particularly of cellars, or house foundations.

The older part of the quarry is flooded and used for a neighborhood swimming pool.

Upland. On the south bank of Chester Creek half a mile west of Upland and north of Barker, a quarry was opened in mica gneiss of the Wissahickon formation many years ago. The quarry face is about 200 feet long, 40 feet high, and directly on a railroad. The schistosity or bedding planes are vertical. All quarrying is by hand drilling. There is no mechanical equipment on the property and it is worked only intermittently by negroes and foreigners for rough building stone. The quarry is on the farm of Alex. Miller.

One mile northwest of Upland at the Bridgewater road forks mica gneiss was being quarried for cellar walls in 1924 by D. F. Green, 1119 Edgemont Avenue, Chester. This is the old Trimble quarry, now owned by John P. Crozier. Four to six men are employed on the face which is 75 feet long and 25 feet high with vertical bedding. The rock is light gray, sandy, mica gneiss of the Wissahickon formation.

Llanerch. Just north of the junction of West Chester pike and Philadelphia city line, on a small branch of Cobbs Creek is a quarry that has been open for many years and is still operated intermittently. It is owned by James Logue who lives close by. The rock is a dense black, fine-grained, sandy hornblende schist, and a coarser black gneiss. Sheetting dips west about 15° , and the jointing is such that the rock tends to split in slabs with square edges. It is used for rough building and foundation stone.

Lansdowne. James Maher, Drexel Hill, operates a quarry on Shady-lane, one-third mile south of Garrett Road, in deeply weathered granite gneiss. Sand is produced by screening the rotten stone, and rough building stone is taken at depth. It is mostly a light-colored granite gneiss with some black mica gneiss. Because of deep weathering, close jointing, and quartz veins 2 to 4 inches wide, this quarry produces a grade of stone suitable only for foundations and backing. The quarry is about 250 feet long and 45 feet deep. Seven men are employed.

Garrettford. The Geo. M. Burnley quarry in Wissahickon gneiss is high on the north bank of Darby Creek near Garrettford. It is 300-400

feet long, having been worked for many years, but is shallow. To a depth of 30 feet the rock is deeply weathered on the joints but is blue on fresh fracture. It is a phase of the Wissahickon gneiss and is quarried for foundation stone. It is possible that good building stone would be found at greater depths where the rock would be fresher and less closely jointed.

Springfield. The Burnley quarry at Springfield in 1927 was producing sand and rough, rusty foundation stone. The rock is coarse-grained gneiss like that in the McVanh quarry near Marple.

The Johnson quarry, opened about 1890, when Springfield was mostly open fields, is now full of water. It produced granite gneiss.

On the west edge of Springfield, on the north side of the highway leading to Marple, is the quarry of D. D. Porta in light blue granite gneiss. It was partly filled with water in 1927 and idle. Across the road from it a quarry in similar rock was worked in 1927 by Massino Bren and others for rough foundation stone.

Morton. One mile northwest of Morton on the north side of the Baltimore pike granite-gneiss has been quarried for forty years, and the resulting excavations are large. The Charles A. Evans quarry, nearest the pike, was being worked in 1927 by Italians, four being employed in getting out building and foundation stone. The stone is coarse-grained blue gneiss, somewhat lighter colored in the present working face at the west end of the quarry. At a depth of about 30 feet, because the number of joints diminished downward, the ledge is fairly massive and blocks up to 3 by 5 feet, and 1 to 2 feet thick, are obtained.

The old Lowne quarry, opened in 1886 by George Lowne, adjoins the Evans quarry on the north. It was operated by Vincenzo Di Francesco of Llanerch in 1927, employing six negroes, one of whom helped open it forty years ago. The quarry is about 400 feet long, 150 feet wide, and about 25 feet deep. The rock is granite gneiss with occasional pegmatite dikes up to 1 foot wide. Some of the gneiss is finely laminated and some is coarse with augens or large crystals of feldspar. The banding is vertical and shear planes are horizontal and 3 to 5 feet apart so that blocks of that thickness are broken out by drilling a line of holes and splitting with plugs and feathers. Two air drills are used. The large blocks are then split to size suitable for building stone.

In places the shear planes are not parallel but one approaches another by an abrupt curve. Where they come close together and are parallel, excellent flags suitable for garden walks and paved terraces are obtained.

Vertical joints decrease from the surface downward and are rare in the quarry floor. Hard blue rock is found almost at grass roots.

In this quarry it was observed that the banding in the gneiss on one side of a pegmatite dike is perpendicular, and on the other side is curved. This suggests that there was movement along a fracture with drag effect produced on one side before the intrusion of the pegmatite; or if movement was subsequent to intrusion, it was after the pegmatite had congealed and took place along one wall of the dike.

At Glen Mills, the General Crushed Stone Company has a quarry 1,000 feet long and with a face up to 100 feet high in gabbro. The rock is banded and dips NW 30°. Most of it is bluish but some is almost black. Some of the rock is said to be as hard or harder than

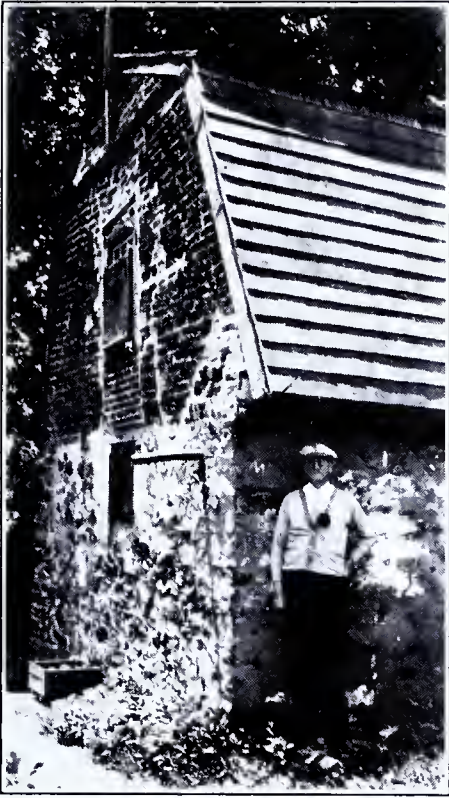


Fig. 81. Caleb Pusey house, built in 1683, Upland, Delaware County. Main walls are mixed rubble; gable (evidently remodeled) is brick, deeply weathered.



Fig. 82. Detail of Caleb Pusey house showing stone sound after 250 years and brick deeply spalled.

trap. Crushed stone is shipped by rail and by truck. This is a large operation, employing power drills, heavy shovels, and a large crushing plant all driven by electric power. Much of the stone is too dark to be desirable for building stone.

Old buildings. The first buildings in Delaware County of course were made of logs but early in its settlement the use of stone began. Rubble masonry for the first simple stone structures was succeeded later by ashlar when prosperity permitted. Many of the earliest stone buildings probably have been replaced, but one, believed to be the oldest house in Delaware County, still stands. This is the Caleb Pusey house in Upland, built in 1683, the year after William Penn landed (see Fig. 1). It is a small, one-story structure, the main walls of which are gneiss rubble and the gables are brick. Although the stone was surface blocks and not freshly quarried, it appears to be perfectly sound after 250 years.

St. Davids Church at Radnor built in 1715 (see Fig. 2) and Radnor Friends Meeting House (1718) just east of Wayne on the Lancaster Pike are two of the oldest religious edifices in the county. They are very simple, one-story buildings of the local gneiss and schist, with here and there a block of quartz. This rubble masonry looks crude and has been repointed, but it certainly is durable. A small stone

platform built against the corner of Radnor Meeting House evidently was for mounting horseback.

Another interesting old church is Chichester Meeting between Village Green and Boothwyn. The present church built in 1769, is a plain, one-story, all rubble building of the native gabbro, in good condition.

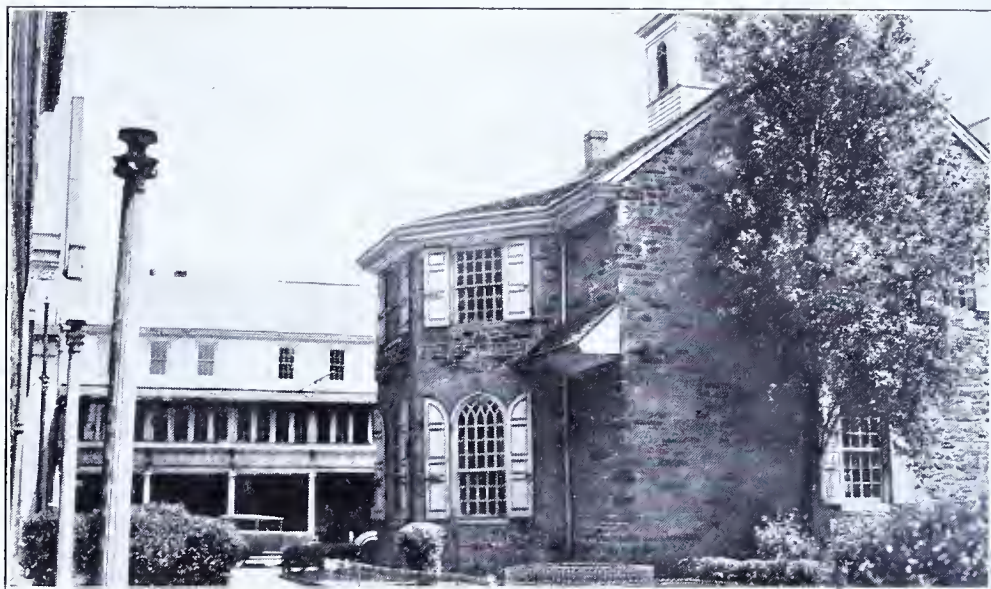


Fig. 83. Old Court House, built of mica gneiss in 1724, Chester. Old Hotel Washington in background.

In Chester a court house was built in 1724 of the local gneiss. It is no longer the court house but still stands in the group of public buildings. It has been continuously occupied as a public building and is now the office of the Delaware County Historical Society. The stone appears to be sound after more than 200 years.

The Thomas Leiper house on Crum Creek, 1 mile south of Swarthmore is notable not only for its granite gneiss quarried and dressed in 1785, for its beautiful but simple portico and doorway, but also for its adjoining impregnable stone store house with narrow slits for windows, and the imported marble path.

New buildings. A few random notes on modern buildings may be of value to some one.

The Delaware County Court House at Media was built in 1914 of marble from Avondale, Chester County. This white marble shows faint blue veining and bands of yellow mica. It has weathered slightly and was steam cleaned in June, 1931. Two wings and a top story added to the Court House in 1931 are blue veined white marble from the Georgia Marble Company.

Delaware County is using white granite from Mount Airy, N. C., for bridges, according to an inspector, because it costs no more than local stone, is regular in thickness and cheaper to lay than local stone of varying thickness, which is harder to dress.

The John Wetherill public school, built in 1930 of granite gneiss from the Leiper quarry near Swarthmore has a distinctly pleasing

appearance as a masonry job. Occasional blocks on edge showing black mica faces, and rare rusty spots lend variety to neat walls. Door lintels 6 feet long are from the same quarry (see Fig. 80).

The Haverford High School (1929) and Clifton School (1930) on the Baltimore Pike are of granite gneiss from the Evans and Lowne quarries near Morton. The Drexel Hill public school (1926) at State Road and Runnymede Avenue is green mica schist from the Foxcroft quarry near Broomall.

The Llanerch School (1913) and the Haverford school (1911) at Oakmont are granite gneiss said to be from Holmesburg, Philadelphia County.

The dam of the Philadelphia Suburban Water Company on Crum Creek 2 miles south of Newtown Square is faced on the upstream side with 55,000 tons of gneiss furnished in 1931 by V. Di Francesco from a quarry on Darby Creek at Eagle Road 1 mile northeast of Marple. The stone on the downstream face of the dam is gneiss from Smith Brothers quarry in a ravine below West Manayunk near the junction of Belmont Road and Rock Hill Road.

ELK COUNTY.

Elk County on the headwaters of Clarion River in a region characterized as a high, dissected plateau and formerly well forested, took its name from the fact that this region was the last retreat of the elk. A herd of 13 individuals lived here in 1841, but they were killed shortly after.

The rocks exposed range in age from the Catskill sandstone up through the Coal Measures to the Mahoning sandstone above the Freeport coal. The Catskill beds are confined mostly to the valleys in the southeast end of the county. The Pocono is largely down in the valleys throughout the county and the Pottsville covers large areas of upland. It is known locally as the Kinzua Creek sandstone, and Olean conglomerate. The Allegheny group or Lower Productive Coal Measures occupies a broad belt but the Mahoning sandstone at the top of the section is found only in scattered hills in the southern part of the county.

Large areas in the county are very thinly settled. A considerable part of the population is grouped in Ridgway, Saint Marys, and Johnstownburg. The demand for building stone has been almost nil except in these three places, and native stone suitable for building is so abundant and readily accessible that it has been used to a rather marked degree in these towns.

The Coal Measure sandstones are variable in texture and color but usually weather to a greenish brown. The Pottsville sandstone or Olean conglomerate where not too full of pebbles, makes good ashlar and preserves its cream, tan, and reddish colors for many years, eventually becoming gray. The Pocono and Catskill sandstones likewise are usable where sufficiently massive.

Stone Buildings.

Ridgway. Elk County Court House (1880) and Jail (1886) at Ridgway are brick buildings on foundations of native sandstone weathered to an even gray. Tool-dressed stones range up to nearly 8 feet long.

Other stone buildings at Ridgway include:

Grace Church (1904) is native sandstone, mostly weathered gray but showing tan in some sheltered places.

First Presbyterian Church (1910) is native gray sandstone in rock-face, random ashlar. Blocks of high relief are dark but not black with soot and the whole effect is good. The stone for this church came from the steep hillside on the edge of town back of the hospital and from the Peter Larson farm 2½ miles north on the road to Johnsonburg. It came probably from Pottsville formation, though it may be Pocono; at least the source was large blocks lying on the surface and not a regular quarry. An addition on the rear of the church is a native sandstone base, but the fine grained greenish sandstone walls are Ohio sandstone.

A large garage of the United Motor Sales Corporation built about 1917 has a first story of heavy rock-face, coursed ashlar made from the local sandstone. It still shows the original pink, tan, and gray of the fresh stone.

The Bogert Hotel, one of the old buildings in Ridgway, has a foundation of native sandstone and the first floor is brownstone. The fresh appearance is due to cleaning by sandblast in September 1929.

Trinity Methodist Episcopal Church (1903) is massive Hummelstown brownstone in good condition, and not badly discolored with soot except the high relief in the lower courses.

The first story of the Ridgway National Bank also is Hummelstown brownstone.

The U. S. Post Office (1916) and Masonic Temple have Indiana limestone bases and trim.

Building stone from the Pottsville formation has come from Hyde Hill north of Elk Creek just east of town, from the hills on the south, and there is said to be hundreds of acres of immense blocks strewn the surface 5 miles west of Ridgway along the slope above the railroad on the dirt road to Brookville.

Johnsonburg. I assume, perhaps erroneously, that it is the Pottsville which outcrops in strong ledges around the tops of the hills at Johnsonburg and strews the slopes with blocks up to 10 feet square. Because of its accessibility the sandstone of the float blocks has been used commonly for foundations of churches, banks, schools, houses, and also for massive retaining walls on hillside properties, and for store fronts. Many of the freshly dressed blocks are very light cream with dashes of red, but in about 20 years they weather to an even gray.

The Johnsonburg National Bank (1890) weathered to gray and was darkened with soot but sand blasting in 1929 restored it to the original charming blend of cream with a little red. Pointing with red mortar increases the color effect.

Saint Marys. Sacred Heart Roman Catholic Church (1906) is all native sandstone, mixed gray and light tan, in rock-face coursed ashlar. In 20 years it has not become much discolored.

Shiloh Presbyterian Church (1900) is native sandstone ashlar now all gray except rare traces of tan. It looks good for centuries. Some blocks are 12 to 14 inches thick and 2 feet long, and single step stones are 9 to 10 feet long.



Fig. 84. Olean sandstone in National Bank (1890). Johnsonburg, Elkhart County.

St. Agnes Church veneered in 1929 with brown rubble and cobbles, and with heavy ashlar for the corners, has a pleasing appearance.

St. Marys National Bank and St. Marys Trust Company buildings are faced with Indiana limestone.

ERIE COUNTY.

Erie is the northwest corner county, bordering on the lake. It rises gently from the lake (elevation 573 feet) southward to an escarpment whose summit is 700 to 900 feet higher. South of this escarpment the upland is 1400 to 1700 feet above sea level. All of the county is covered with glacial drift and exposures of bed rock are rare in large areas. Portage sandstones and shale border the lake shore. Girard and Chemung shales underlie the broad terrace devoted to vineyards. Catskill beds are next on the south, and the Pocono sandstone occurs along the Erie-Crawford county line and in isolated patches in Wayne and Amity townships, and between Waterford and McLane.

Building stone has been produced at numerous localities in years gone by, but I learned of no place where it is being quarried now. Glacial boulders, mostly granite and gneiss from Canada, have been used here and there for home and barn foundations and for the walls of buildings. In Edinboro two houses have porches of split boulders. The rock undoubtedly is durable but the fresh fracture faces of different kinds of rock give the masonry a bizzarree appearance.

In Northeast I observed house foundations, a few porches and chimneys built of glacial boulders, either round or split. The rock garden and shrine at the Catholic College also is of granite boulders glacially transported from Canada. The brick buildings of St. Mary's

College at Northeast were being veneered in 1928 with granite gneiss from Port Deposit, Maryland.

The Portage group consists of alternate layers of gray shale and thin hard sandstone and occurs mostly east of Erie, where it is exposed in the beds of the creeks emptying into the lake. The accompanying picture of the rocks in Twelvemile Creek at the Lake Shore road illustrates the character of this formation. One would unhesitatingly call such an outcrop worthless as a source of building stone, and so it would be as a commercial proposition. Nevertheless very attractive



Fig. 85. Flaggy sandstone in Twelvemile Creek, near Northeast, Erie County.

masonry can be built from stone such as this, if the builder is after effect regardless of expense. An illustration of the use of the Portage flags for construction is the house of W. T. Crawford on the Lake Shore at Northeast. The lower story is stone and the upper one stucco. Many of the flags used are barely more than an inch thick. They are laid in regular courses, short pieces mixed with long ones. The natural taper or irregularity in thickness of the flags adds much to the effect. As shown by the photograph, the semi-circular rays over the round-topped door, produced with flags of irregular length and thickness, and repeated in stucco at the peak of the gable above, are architecturally interesting.

This sandstone is bluish-gray, fine-grained, non-fossiliferous, and in places beds 4 to 8 inches thick are found.

A small, one-story stone house, formerly a district school, on the Lake Road $7\frac{1}{2}$ miles east of Erie is of local gray sandstone 5 to 6 inches thick. The edges of the blocks show fine cross-bedding. This building is 75 years old and the stone is still in good condition. This is believed to be from some of the thicker layers of Portage flags.

Quarries are reported at several places in the oil sands or sandstone members of the Catskill formation, but they have not been operated for many years and now are generally overgrown. This

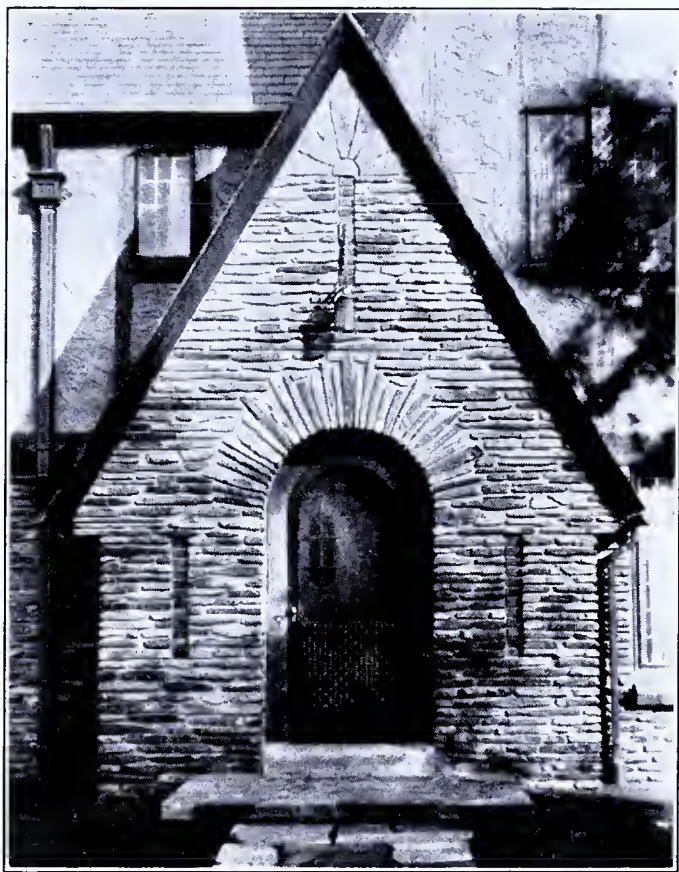


Fig. 86. Crawford residence on Lake Shore road, Northeast, Erie County, showing use of flaggy stone for building.

group makes an escarpment overlooking, and several miles south of the lake. The building stone taken from the group is described as bluish-gray, fine-grained sandstone, containing many fossil mollusks and fucoids, occurring in layers 6 inches to 2 feet thick, and smelling of petroleum. The stone dressed rapidly and made a fair building stone, but the smell and the fact that petroleum sometimes oozed out and stained the rock after it was in the wall were against it. Such stone was quarried 50 years or more ago by a Mr. Howard 8 miles south of Lake Erie in Franklin Township; on the left bank of French Creek 1 mile southwest of Le Boeuf Station at the Carroll quarries; and in the Middleton and McClelland quarries at the southeast corner of Waterford Township on opposite sides of a small stream. These quarries furnished window and door sills, door steps, and other dimension stone for many buildings in Erie and in neighboring villages. In 1880 I. C. White wrote¹ "The Eagle hotel in Waterford was built of this stone more than 50 years ago, and yet the smell of petroleum still pervades it. Many of the blocks of stone were so saturated with oil that it has run down the sides of the building and blackened several courses."

¹ White, I. C. The Geology of Erie and Crawford counties; Pennsylvania Second Geological Survey, Q4, p. 269, 1881.

At Corry I was told that thin-bedded bluestone was once quarried at the top of the hill at the end of Centre Street. This may be the locality mentioned by White. He said in 1880 there were two extensive quarries 1 mile south from Corry in the summit of a hill west from the Methodist church. He called it the Corry sandstone and described it as yellowish or buffish white, hard and fine-grained, in a bed 8 feet thick. The upper half of the bed was shattered and the lower half in 2 to 12 inch layers. At other places in Coneord Township blocks of this sandstone lying on the upland are abundant and have been broken up for building stone.

Some of the old masonry, especially foundations, in Corry doubtless is from the local quarry. The post office here is Indiana limestone.

White recounts (Q4, p. 291) that rough stone, used principally in cellar walls in Erie, was quarried in Neelys Run 2 miles east of Erie, and in Fourmile Run. In this run, near the Lake Shore, a sandstone only $2\frac{1}{2}$ feet thick was quarried. It was bluish-gray rock, smelling strongly of petroleum. Farther up the run and 65 feet above the lake was another quarry on a 3-foot bed of oil-bearing bluish-gray sandstone. On Neelys Run the quarry was $\frac{1}{4}$ mile south of lake on a 3-foot bed of similar sandstone in 3 layers 18, 12, and 6 inches thick.

In Erie I saw no buildings that seemed to be of Pennsylvania building stone. The Roman Catholic Cathedral completed in 1893 is red sandstone from Medina, N. Y., trimmed with white sandstone from Amherst, Ohio, and Mercer County, Pa. The Lutheran Memorial church is seamfaced Barre granite, and the Federal Building with its walls much soiled appears to be Ohio sandstone. Brick, tile and imitation stone are common building materials here, with Indiana limestone, Ohio sandstone, and polished serpentine used for trim.

FAYETTE COUNTY.

This county, named for the Marquis de la Fayettee (or Lafayette) is on the southern line of the State between Greene and Somerset counties. Monongahela River forms its western boundary and the Youghiogheny crosses it.

The rocks outcropping in Fayette County extend from the Catskill red beds through the Pocono, Mauch Chunk and Pottsville series, and all of the Coal Measures. In this long section of sedimentary rocks are several sandstone members, some of which are hard, massive, form prominent ledges, and yield building stone of fair quality. For the most part the native stone has been used only locally, though some has been shipped. Of course the main use has been in rough work, for foundations, barn walls, retaining walls, etc., but some prominent buildings in the county are of local stone, and some even are ornamented by carving.

Most of the native sandstone either weathers to a brownish color or when used in the larger communities becomes deeply stained with soft coal soot.

The Waynesburg sandstone in many places is soft or shaly but it is reported to make cliffs on the river bluff in German and Luzerne townships, where, being massive, it is suitable for building stone.

The Mahoning sandstone is said to be commonly present at its horizon, though in some localities it is represented by shale. It is often flaggy,

but where massive it is coarse-grained and as it contains feldspar, it changes color on weathering.

The Saltsburg sandstone is hard and massive between Paintersville and Flatwoods, and on both sides of Youghiogheny River east of Perryopolis, and has been quarried in several places.

The Homewood sandstone is the most massive bed, and has some topographic expression. It is somewhat coarse-grained in places, and would furnish blocks of large size. It is conspicuous on steep slopes and spurs of Chestnut Ridge in North and South Union and Georges townships, along the Youghiogheny at Ohioptyle, and on Laurel Ridge.

The Pocono sandstone occurs along the west flank of Laurel Ridge, on Dunbar Creek, and on Chestnut Ridge, especially in the vicinity of the Summit Hotel on the National Highway. It is about 600 feet thick; the upper part is hard and flaggy and the lower part conglomeratic.

Uniontown, which was named from the uniting of several small places, has a number of stone buildings of more than passing interest. The new court house was the most conspicuous construction in the center of the city in 1928. It is faced with Cleveland sandstone. The interior is trimmed with various Italian marbles and the floors are Tennessee marble, making a building of which the county can well be proud. The old court house, built in 1890-92, is of massive sandstone said to have been quarried on the top of a hill at Layton station on the B. & O. R. R. (See Fig. 6). This place is on the north bank of Youghiogheny River near the northern boundary of the county and 1½ miles east of Perryopolis. I have not visited it but understand that the quarry has not been operated in recent years. This is a medium-grained arkosic sandstone occurring probably in thick beds and having a gray to light tan color. Like most of the stone buildings in Uniontown it is now stained very dark, almost black in places.

The sandstone in the hill back of Layton is the Saltsburg occurring in the Conemaugh group. This sandstone was quarried also farther east on this ridge at Fort Hill but operations there have been long abandoned. It was formerly quarried on the south side of Youghiogheny River 2 miles southeast of Perryopolis and west of Virgin Run. The quarry was at the top of the steep river bluff and the stone was lowered to railroad level on an inclined tram. The Saltsburg sandstone was quarried many years ago on Chestnut Ridge between Flatwoods and Paintersville, according to Campbell in the Brownsville—Connellsville folio (U. S. G. S.), but I have no further information on this locality.

The First Presbyterian church in Uniontown was built in 1896 of sandstone from Berea, Ohio. Carving around the main entrance is a striking feature of the building and shows what can be done with this stone.

Asbury M. E. church, the Seaton building, and residences of Samuel Hogsett and J. P. Conn are Hummelstown brownstone. Most of the stone buildings in Uniontown are stained very dark, particularly the first floor, probably with soft coal smoke.

Hopwood, 4 miles east of Uniontown, has several old sandstone houses. As there is no known quarry near by the source of the stone is believed to have been great blocks lying on the mountain side just east of the village, where blocks of gray sandstone up to 12 by 15 by 20 feet are still to be seen along the National Pike. Old residents say

that years ago a Pittsburgh contractor took many stones for massive bridge masonry from the place.

The first stone house seen on entering Hopwood from the east is a two-story residence with a tablet carved "William Morris, September the 7th, 1818." Most of the wall is irregular shaped, rough surfaced blocks showing little trace of bedding and so probably derived from massive layers. In contrast the lintels and corner stones are dressed fairly smooth, but the color of all the masonry is an unattractive light brown.



Fig. 87. House at Hopwood, Fayette County, built of local sandstone in 1839.

The next stone building is a two-story structure, built in 1839, according to a carved tablet, and used originally as a hotel but now as a store and residence. Across the street is a two-story house built in 1839, the front of which contains upright panels about 18 inches wide and 8 feet long, and other blocks dressed smooth on the margins and ornamented in the corners with fan-shaped tooling. A one-story stone house next door is of about the same date. The stone in all these old buildings at Hopwood is medium-grained, gray when fresh, and weathers to a brown that is typical of Coal Measure sandstones.

The only quarry operating in the vicinity in 1928 is on the National Highway east of Hopwood and below Big Trough spring where a heavy bedded, dark gray, fossiliferous limestone about 20 feet thick is being quarried and crushed for township roads. This limestone might be used for rough building. A large quarry was opened on this limestone along the highway on the east side of Chestnut Ridge by the State Highway Department. It is the Greenbrier limestone in the Mauch Chunk red shales.

The Summit Hotel on the crest of Chestnut Ridge on the National Highway is built in part of local sandstone, as is also the lunch room and garage. The blocks are mostly 3 to 8 inches thick, a gray stone with dark brown stain on some joint faces. They probably are Pocono sandstone from somewhere on the top of the ridge.

According to Stevenson,¹ the Pocono sandstone "is reached again at the summit and huge masses of the conglomerate layers lie strewn over the ground in the woods north from the Summit House. Just beyond the house and at a little south from the National road, the flaggy layers, belonging midway in this series, have been quarried for use as a firestone in lining blast furnaces."

Stone House, a hotel on the National Highway, 7 miles east of Uniontown was built in 1822, probably of sandstone from ledges or loose blocks near by. The stone is dressed to rectangular blocks, some of fairly large size, and all is weathered to a light tan.

On the road from Farmington to Ohiopyle there are superb outcrops of sandstone, and at Ohiopyle the Youghiogheny River falls over the massive Pottsville sandstone. Large blocks of it below the falls at the mouth of Beaver Creek show cross-bedding and the imprint of fossil shells, and an abundance of small quartz pebbles. Material for rough heavy masonry could be obtained here in abundance.

Two miles below Ohiopyle at the mouth of Bear Run (Kaufmann Station) on the old Stiekles place is an abandoned quarry from which massive sandstone blocks were shipped by rail. The site is in the steep river bluff just above the mouth of the run and 200 feet above the river. The quarry face is about 100 feet long and 75 feet high. The cliff is soft sandstone and grit, which on fresh fracture is light tan, white, to pinkish. The large blocks piled in front of the quarry are black, probably from locomotive smoke. A derrick was used for moving blocks from the quarry face to a small tram, on which they were lowered to the railroad. This quarry furnished stone for the Fayette County Court House. This is the Pottsville sandstone. Large blocks and ledges of it are exposed in the narrow defile of Bear Creek between the river and Kaufmann's camp.

At Point Marion a sandstone 200 or more feet below the Pittsburgh coal outcropping just above the level of the Cheat River bridge has been quarried for local use. A quarry in a sandstone ledge near river level 2 miles below Point Marion has not been worked for many years. These sources have supplied good gray sandstone for curbs, sills, steps, and building, mostly rough foundations, but some dressed blocks.

Brownsville has several old sandstone buildings, material for which was quarried on the edge of town. At the head of Market street is the Girard Hotel, built by John and Nancy Hezlip, 1800, and near it a residence, formerly the Brashear Inn, built and used as a hotel before 1800. It was built by Basil Brashear and later operated by Barney Brashear, father of John A. Brashear who was raised here. Lafayette stopped at this hostelry in 1825. The building may be identified by the carved wooden fluting around the doorway.

The Catholic church on the hill above town, completed in 1845, is of stone quarried behind the building. Foundation and coping stone range up to 12 by 42 inches and in the main wall many are as large as 10 by 36 inches. The sandstone is gray and coarse-grained but now bears much black stain. The stones in this church were not dressed as smooth as might have been and some were laid on edge, which has resulted in slight scaling. Christ Church Episcopal (1855) is said to be from the same quarry and looks like better masonry.

Nemacolin Castle, the home of Charles Bowman, is partly of sandstone quarried here, as is the wall surrounding the property.

¹ Stevenson, J. J., *The Ligonier Valley: Pennsylvania Second Geological Survey*, Rept. KKK, 1878.

Limestone quarried at Brownsville for crushed stone is 15 feet thick but apparently is not suitable for building stone because it has a very irregular fracture and breaks down to chips on exposure.

Dunbar produces silica sand from two quarries high on the hill about 1 mile east of town but no building stone. These quarries probably are in the Homewood and Upper Connoquenessing sandstones. The lower quarry exposes a massive ledge 40 feet thick, the upper part of which is particularly solid and would furnish large dimension stone. The fresh stone is white, light tan or pink, but it weathers gray and stains dark. It is a coarse-grained silica sandstone, gritty in places but not conglomeratic. The rock in the upper quarry is not so massive and some of it at least is soft.

I have been told that a mill built by George Washington at Perryopolis is still standing, and that the foundation and chimney are local stone. Also that a restaurant and barber shop in Perryopolis occupy the first bank building erected west of the Alleghenies, and that it is a stone building.

FOREST COUNTY.

Forest County lies between Warren and Clarion, and took its name from the great expanse of forest. The name is equally applicable today for most of the county is in timber. Only two other counties, Pike and Cameron, have fewer people per square mile. Naturally in a sparsely settled and much forested wilderness there has been little or no development of the building stone.

According to the Second Geological Survey the county is a plateau about 1700 feet high, trenched by Allegheny River, Tionesta Creek, and numerous small streams. As in Warren and McKean counties, the Pottsville sandstones, known here as the Johnson Run sandstone, Kinzua Creek sandstones, and Olean conglomerate underlie the plateau, and as they lie nearly horizontal, the uppermost or Johnson Run sandstone caps the highest ridges. This stone is coarse-grained and ferruginous and weathers to a greenish brown, so is not an attractive, though it may be a durable, building stone.

The Kinzua Creek sandstone is commonly gray or white but in places may have a pink tint. It is likely to be friable, but should be satisfactory for local needs, as a building stone. This sandstone is in two benches aggregating about 10 feet thick.

The Olean conglomerate is a formation consisting of coarse-grained gray sandstone in beds 2 or 3 feet thick separated by layers containing quartz pebbles ranging in size up to half an inch in diameter. The lower layers contain more pebbles than the upper. Some of the sandstone contains so much iron that it weathers brown but some layers are clean white quartz sand hard enough to make good building stone.

The Kinzua Creek sandstone and Olean conglomerate, by their resistance to weathering, outcrop in cliffs or make a distinct bench in the profile of the hills. The conglomerate in particular breaks up in large blocks which become separated from the outcrop and may move down hill or remain on the crest of ridges. Blocks of Olean conglomerate are reported measuring 20, 40, and 50 feet square and 20 to 30 feet high.

According to maps of the county, the Pocono sandstone occurs along

the larger streams. If it is a massive, fine-grained sandstone it probably makes cliffs 50 or more feet high, and being along the railroads might be considered the most accessible source of building stone.

I have not been in the county, and so have no personal knowledge of the use of the native sandstones.

FRANKLIN COUNTY.

Just why a beautiful agricultural district in the middle of the south tier of counties was named after a famous Philadelphian, I do not know, but be that as it may Franklin County would do honor to the greatest of names. Bounded on the east by South Mountain and on the west by Tuscarora Mountain, it lies in the Cumberland Valley, a fertile lowland that early attracted settlers.

Chambersburg, named for the Scotchman, Benjamin Chambers who laid it out in 1764, and now the county seat with a population of about 13,000; Mercersburg, the seat of a famous boys' school; Waynesboro and Greencastle, were begun in the days when labor was cheap and houses were built for use and not for sale. Although brick made from local clay was the commonest building material, nevertheless stone dwellings were not unusual and these were built of the limestone that underlies half of the broad valley.

This limestone of Cambro-Ordovician age is known as the Trenton or Shenandoah limestone, and is divisible into several formations, including the Tomstown, Beekmantown, and Chambersburg limestones.

East of the great limestone valley is South Mountain, with a core of ancient volcanic rocks capped and flanked with hard Cambrian sandstone and quartzite. West of a line through Chambersburg and Greencastle is a broad belt underlain by Martinsburg shale, including its sandy member at the top. West of this belt, around Mercersburg, is another limestone area, and then come the sharp ridges that characterize the western part of the county. These ridges and their intervening valleys are made of sedimentary rocks in great folds, including Silurian sandstones, Helderberg limestone, and Clinton, Cayuga and Chemung shale. Tuscarora Mountain, Cove Mountain, and North Mountain are capped by Tuscarora sandstone, formerly called the Medina.

With all these formations exposed in the county, stone for local building is abundant. The limestone commonly is in beds thick enough for building stone and not too closely fractured. Much of it is dark on fresh fracture but weathers to light-gray. Old stone houses and bridges vouch for its durability. In these days of concrete construction, the limestone is used for foundations and crushed for roads and concrete, and only occasionally used as building stone. Very recent examples of its use for building are the new administration building at Mercersburg Academy, and the library and Riddle dormitory (1928) at Wilson College, Chambersburg.

In South Mountain loose blocks of the red rhyolite gathered from the surface have been used occasionally for building stone, mostly in the rough or with very little trimming. The stone pillars at the entrance and part of the chapel at Mont Alto Sanitarium are of red amygdaloidal rhyolite, which has very satisfactory appearance and can be procured in some places without the cost of quarrying. This

stone, together with sandstone, conglomerate, and vein quartz, all rough blocks from surface float, was used in the Hawley Memorial chapel at Monterey. Greenstone, an equally hard volcanic rock occurring in South Mountain, was used in rough blocks at Blue Ridge Summit in the foundation of the First National Bank, in a residence across the street, and in the old hotel building west of the railroad station.

Mercersburg is an old settlement and has a number of interesting and old stone houses, all built of the local limestone that weathers to light gray. A house on the southeast corner of the square was built in 1796 and several others were built at about the same time. A two-story limestone house with an arch in the end wing was built for the widow of William Smith in 1786 and is still standing, as is Squire Smith's one-story house. Mercersburg Academy buildings are mostly brick, but the new chapel is Plymouth, (Mass.) seam-face granite trimmed with Indiana limestone and the Administrative Building is selected thin limestone from Dickey Station 3 miles north of Mercers-



Fig. 88. Administration building, Mercersburg Academy, Franklin County; shows use of local thin-bedded limestone.

burg. This native limestone in blocks 2 to 3 inches thick and with natural face makes a pleasing wall, both in color and texture. This building, erected in 1921, is a little gem of masonry, and shows what can be done with the native stone by a little extra effort.

The S. Dickey farm house near Dickey Station is of large blocks from the same quarry. It was built 75 years ago and shows how clean the stone will stay in a rural atmosphere. The quarry, owned by Russell Guyer, is operated mostly for road metal. The beds strike N. E. and dip N. W. 25° towards the creek. It yields stone up to 8 to 10 inches thick and 2 to 3 feet long if desired. The fresh rock is dark colored but it weathers to light gray.

Five miles west of Greencastle and half a mile west of Upton is a quarry in vertical limestone beds, operated in 1927 by Bitner & Goetz for building stone and crushed stone. This limestone also is dark but weathers very light. The stone for Riddle Hall, Wilson College, Chambersburg was taken from this quarry in 1927.

Another limestone quarry in the south edge of Fort Loudon may have furnished some of the stone used for building in that vicinity. The monuments or historical markers erected in 1915 in the village, at the site of the old fort, and the one just east of the village are Woodstock granite from Maryland.

At Markes or Bridgeport, half way between St. Thomas and Mercersburg, are two well built limestone houses and a bridge over West Branch of Conococheague Creek that are worthy of notice. This was the site of McDowell's mill, one of the first forts and mill sites in the county.

At Charlestown, 3 miles northwest of Mercersburg, is a church of dressed, selected light-colored sandstone, with a few dark or iron-stained faces. The whole effect is light-colored and good. Several home foundations are of the stone, and at Foltz in Cove Gap an old store, blacksmith shop, and houses are of coarse-grained, light-colored sandstone and quartzite. This stone is basal Silurian, perhaps Tuscarora or Juniata sandstone, float blocks of which are very abundant on the mountain side. About $\frac{3}{4}$ mile north of the highway at Cove Gap in the ravine known as Stony Batter is the birth place of President James Buchanan, the site of which is now marked by a pyramid about 15 feet high, built of rough blocks of this native sandstone.

On the east face of the mountain along the road to McConnellsburg are great blocks of white, highly siliceous sandstone, and exposures of the same in the road cuts. All along the mountains in the western part of the county white and light gray quartzites and buff, tan, pink and red sandstone make abundant float and would seem to be a ready source of building stone, but some say it costs more to get the material out than it is worth. There is no question as to the durability, attractive color, and dressing quality of the stone.

On the east side of the county Cambrian quartzite is abundant and has been quarried at Caledonia Park and Mont Alto. Much of it is massive and thick-bedded and breaks into irregular blocks, but in some places quartzite next to the limestone occurs in thin, even layers. At one such place north of Caledonia Park thin beds have been quarried and used to build houses in villages along the Lincoln Highway in that neighborhood. The more massive quartzite has been used for fences, fireplaces, and walls of summer houses. At Mont Alto Forest School the entrance gates, bridge, and administration building and dormitory are built of Antietam sandstone or quartzite quarried on the mountain back of the school. The stone is variegated cream to red and makes attractive masonry. It is very hard, dresses well but with difficulty, and preserves its color for many years, at least in a rural atmosphere.

Two bungalows in Mont Alto are of cobbles from the mountain wash. The general effect is brown.

Waynesboro has few stone houses built of limestone from local quarries. Some of the curbing and flagging in Waynesboro was quarried there from thin sandy beds at the top of the Waynesboro limestone formation.

Marble occurs in several places in Franklin County, but in most places offers little prospect of being worthy to develop. Perhaps the most promising place is $3\frac{1}{2}$ miles east of Greencastle and $1\frac{1}{2}$ miles southeast of Clay Hill where a pink marble with green veins outcrops near a farm house. No attempt has been made at quarrying and it is not known if the stone could be obtained in large pieces, but the color at least is pleasing.

FULTON COUNTY.

The county without a railroad, named for Robert Fulton though it has no navigable waters, is in the middle of the southern tier of counties. All its rocks are sedimentary and the formations range from the Trenton limestone to the Coal Measures. Limestone and sandstone are the only sources of building stone.

Stone buildings are rare except in the county seat. The pioneers had to clear the forest, and the logs from the clearing made their houses and barns. Log buildings still stand on the main street of the county seat, though the logs may be concealed by clapboards. When frame houses were built the need for plaster resulted in the local limestone being quarried and burned for lime. Perhaps it was a quarry opened at McConnellsburg for this purpose that furnished the stone



Fig. 89. Trenton limestone in Fulton House (1793), McConnellsburg, Fulton County.

for the old tavern, the Fulton House. This building, part of which dates from 1793, is of Trenton limestone, which underlies the valley for several miles north and south of McConnellsburg and used to be quarried within the borough. It weathers to a gray of pleasing color, breaks in blocks 6 to 10 inches thick, and makes a very durable building material.

Several other limestone houses face the Lincoln Highway in McConnellsburg. The oldest residence is said to be the McCullough house, which is opposite Hotel Harris. It was built about 1795. The Irwin residence on the next corner east of the Fulton House bears a tablet "Built 1793," and a stone house with two front doors in the next



Fig. 90. Oldest residence in McConnellsburg, Fulton County, built about 1795.

block east, is said to be well over 100 years old. In these and other old stone buildings in McConnellsburg the fronts are ashlar, and all limestone but the ends and backs are mostly rubble and may contain some red sandstone mixed with the gray limestone. The basement walls of the Court House and Methodist Episcopal Church are of local limestone.

The largest limestone quarry in Fulton County is that on the Patterson Brothers farm half a mile south of McConnellsburg. It has a face 300 feet long and up to 70 feet high and has been worked by the State Highway Department for crushed stone. It is in dark blue

Trenton limestone that weathers to light gray. Many of the beds are thin but they are interspersed with thicker beds suitable for building stone. The beds dip into the hill at 20 degrees. Other quarries 2 miles south and southeast of McConnellsburg that have been opened for lime, but might furnish building stone are on the C. J. Brewer, George Magsam, and Gress farms.

At Warfordsburg about 2 miles north of the Maryland line, is a limestone quarry developed for 100 feet along the outcrop of beds dipping 12 to 25 degrees out of the hill. This dark Helderberg limestone weathers to light gray and was used in building the adjoining house now occupied by W. B. Rauk. It is reported that the aqueducts on the canal at Hancock, Md., were built of stone from this quarry. Some of the beds are massive and it would be possible to get massive blocks here. Rock for the State Highway close at hand was obtained here. Now it is quarried only intermittently for neighboring farmers to burn into lime. Black limestone is quarried 2 miles north of Warfordsburg by G. E. Golden, and several openings have been made near Needmore to get stone for burning to agricultural lime. Also near Fort Littleton and Burnt Cabins the Helderberg limestone has been opened and building stone could be obtained from these quarries.

On the Orbisonia road north of McConnellsburg is a farm house built of rough sandstone blocks, that had been gathered from the surface. Different colors and irregular shapes make the masonry doubly unattractive.

The Medina sandstone at the crest of Cove Mountain all along the east side of the county is coarse-grained and white and has been used in a small way for rustic masonry at L. W. Seylar's place on the mountain 4 miles east of McConnellsburg.

The Pocono sandstone strewn the flanks of Sideling Hill with large blocks and Wrays Hill on the Bedford County line is covered with the same stone which usually is sufficiently hard and massive to be suitable for building stone.

GREENE COUNTY.

Lying in the southwest corner of the State and in the deepest part of a structural trough, Greene County contains the highest beds, stratigraphically, in the Coal Measures. The section extends from well-below the Pittsburgh coal up to 1,000 feet above the Waynesburg coal. Massive sandstone occurs at several horizons in this section, and shelly or thin-bedded sandstone is common. Most of this rock is medium-grained, free from pebbles, arkosic, and weathers to a greenish tan or sickly brown. Sandstone has been raised for building purposes in many, perhaps most, of the townships but this was 50 to 100 years ago and many of the places were worked only for one house or a barn foundation.

Limestone occurs throughout the county but mostly in thin beds not suited for building stone. The Benwood limestone outcropping along Monongahela River has layers 30 inches thick but this stone has uneven fracture, is hard to dress into shape, and, so far as I observed, has not been used for building stone.

The most conspicuous sandstone in the county is the Waynesburg, occurring over the Waynesburg coal. It is 40 to 70 feet thick, likely

to be flaggy as well as massive, and cross-bedding is not uncommon. It is coarse-grained, light gray to yellowish gray or buff, and has been used for rough masonry and for road metal. It is well exposed at Durbin, Mt. Morris, Whitely, Carmichaels, and along Tennile Creek between Laurel Run and Jefferson.

The Waynesburg sandstone is so variable that it is an uncertain source of building stone. In some places it is soft, easily broken, and unfit for such use; in other places, though hard, it may be too thin-bedded.

In recent years building stone has been quarried commercially in only one place in Greene County. This is $1\frac{1}{2}$ miles south of Waynesburg on the Hook farm where a sandstone ledge outcropping in a small run was worked nearly a hundred years ago (1835) to provide material for a farm house. This house on the Smith Creek road is in excellent condition and shows the durability of the stone. It may have slightly more of a brownish tinge than will be acquired by the stone quarried now because it was taken from the outcrop.

The Waynesburg Brick and Stone Co. bought the property in 1906 and took out stone along the run until the overburden became excessive. In later years this ledge has been quarried in the floor of



Fig. 91. Sandstone quarry, Brick & Stone Co., Inc., Waynesburg, Greene County. In floor of brick shale quarry.

the shale quarry at the brick yard. Three feet of thin-bedded sandstone of no value lies between the shale and the building stone. Below it are three layers each about 2 feet thick, then a 4-foot and a 6-foot layer, or 16 feet of good stone. I cannot vouch for the 6-foot layer because it was not fully exposed when the quarry was visited. These layers are massive bedded, the stone is light gray, even and fine-grained, and works well, both in lifting from the bed and in dressing to shape. It is soft when freshly quarried but the surface hardens in time and preserves tool mark indefinitely.

This sandstone looks so much like the Indiana limestone that, seen

from across the street, it might be mistaken for that popular stone. Being silica instead of lime it may be more durable. Experience in Waynesburg shows that in a rural community at least, the stone retains its even gray color and does not develop iron streaks or stains. Examples of its use in Waynesburg are the South Side school, Long store, several residences, the First Christian church, and the Soldiers and Sailors monument. It seems to be well suited for office build-



Fig. 92. Local sandstone in store front, Waynesburg, Greene County.

ings, residences, and monuments but the production has been limited to local use by lack of advertising, transportation difficulties, and the quarrying problem. It lies in such a position that large production means very heavy stripping or underground mining, either of which would be prohibitive. The small present output is commercially possible because the stripping has been done to get shale for making brick.

This particular ledge, which is about 150 feet above the Waynesburg coal, is said to have been opened on other farms on Smith Creek but is not worked. The quarry just above water level on the south bank of Tenmile Creek opposite the old tin mill at Waynesburg seems to be at about the same horizon as the quarry on the Hook farm. It discloses 20 feet or more of massive and shaly sandstone. The massive stone seems slightly coarser-grained and softer than that in the Hook quarry. It has not been worked for many years.

This ledge should be about 50 feet above the creek opposite the railroad engine house at Waynesburg but it is concealed by talus and trees. The quarry high in the bank at this place was opened about 1900-1902 to furnish crushed stone for the village streets. It has a face about 250 feet long on a 30-foot ledge. The upper part is irregular bedded and slabby and the lower part massive. It looks as if good dimension stone could be obtained here, but it is said the stone does not split well. Being in a steep bluff the present 30-foot overburden would increase rapidly should the quarry face be advanced.

Local sandstone was used many years ago for foundations of bridges in all parts of the county. Examples of such use are seen at Ryerson Station, Durbin, New Freeport, Deep Valley, Rogersville, Jefferson,



Fig. 93. Local sandstone in bridge, Rogersville, Greene County.

Carmichaels, and many other places. The abutments of the bridge over Tennile Creek at Rogersville are sandstone blocks 12 to 15 inches thick, 20 to 24 inches wide, and up to 5 feet long. Old residents say they must have been quarried nearly a century ago. These and some of the curb and flagstones in the village are of local origin. The stone is weathered to a greenish-brown but is in good condition, evidencing its durability. Sandstone blocks of similar size in the bridge at Durbin, laid without mortar, are in good condition after several decades.



Fig. 94. Local sandstone in church steps, Swarts, Greene County.

Old stone houses, like that on the Throckmorton farm west of Rogersville built in 1823, are not numerous in Greene County, but the few seen bear evidence of the suitability of the common sandstone for building blocks, if one does not object to the queer brown color to which most of it weathers. Other uses of local sandstone noted in Greene County that evidence what can be done with it as a building stone are noted here:

The power house of the Diworth Coal Company at Rices Landing built with Pittsburgh sandstone taken from the mine shaft. Lock No. 6 at Rices Landing was built of Waynesburg sandstone quarried near by, as was also a stone house here, now about 150 years old. The foundation of the First National Bank at Carmichaels is of dressed Waynesburg sandstone from a quarry on Marshall Collins' land. The Baptist church at Greensboro is built of native sandstone. At Swarts the door step of the S. C. M. E. church is a single stone measuring 6 feet by 3 feet 8 inches, and 7 inches thick. It and the step stones are examples of good stone dressing, and with the blocks in the foundation of the church, and of a near by house and barn, illustrate the suitability of a local sandstone for construction. It is even-grained, of a brownish hue, and wears well.

HUNTINGDON COUNTY.

This county, named for the city, which in turn was named for Selena, Countess of Huntingdon, is one of the larger counties in the State, and very definitely rural in aspect. It is in the central part of the State, south of Centre County, and crossed by Juniata River and the main line of the Pennsylvania Railroad. It is in the Vallemont region and geologically very like Blair, Bedford, and Centre counties, the geologic section extending from the Trenton limestone to the Lower Coal Measures.

As is common in this region the hard massive sandstones make the mountain ridges, areas of limestone are low land, and because of the regional folding of the earth's crust the rock formations are exposed in bands with a northeast trend. Because of this folding too the formations are repeated across the county. The Medina sandstone occurs in three ridges and the Oriskany sandstone in five between Tuscarora and Tussey mountains.

On a geologic map the conspicuous features, besides the direct and parallel courses of the formations, are the broad Trenton limestone valley in the northwest corner of the county between Spruce Creek and Warriors Mark; the many miles of Oriskany sandstone outcrop, and its broad expanse on the highland west of Huntingdon; and the Broad Top coal field.

The building stones of course are the harder and thicker-bedded sandstones and the limestone.

The principal area of Trenton limestone is the broad valley in the northwest part of the county between Bald Eagle and Tussey mountains. Other areas of this limestone are in Black Log Valley and along Goslin Run.

The Helderberg limestone and Oriskany sandstone cross the county in six narrow belts in Black Log, Germany, Aughwick, and Hares Valleys and on Warriors Ridge. Between Huntingdon and Petersburg the band of Oriskany outcrop widens to 3 miles and the stone is so deeply weathered in places that it is crushed for building sand.

The Pocono sandstone makes a hairpin loop around Broad Top, being the weather-resisting beds in Terrace Mountain and Sideling Hill. Broad Top itself is underlain by the Pottsville sandstone and Coal Measures possibly up to the Waynesburg sandstone.

The Butler sandstone in the Broad Top is light-colored and invariably contains coarse, white sand grains or small, white, opaque quartz pebbles and is exposed north of Dudley.

I do not know any place in the county where building stone has been quarried.

Stone Buildings.

Huntingdon. St. James Lutheran Church is Hummelstown brown-stone and the U. S. Post Office is Indiana limestone. The First M. E. Church (1910) is Indiana limestone in alternating 4- and 10-inch courses of rock-face ashlar, trimmed with the same stone with planed faces. Abbey Reformed Church (1928) is Plymouth (Mass.) seam-face granite, trimmed with Indiana limestone.

Although the Oriskany sandstone outcrops abundantly around the town, the only structural use of it that I observed is in fences, foundations, retaining walls, and river revetments.

Spruce Creek. In the broad valley north of Spruce Creek, limestone has been used here and there for farm houses and barn foundations. Two or three old limestone houses at Spruce Creek and the Presbyterian Church, and an old mill and a farm house at Graysville are examples of the use of this native limestone, all of which weathers to a medium gray.

At Water Street is an old stone house with a front wall of local Trenton limestone dressed to regular blocks, and three other walls of vari-colored sandstone rubble.

At Shade Gap is a single stone house of rough field stone, different colors of sandstone giving an unattractive effect. The masonry is split from ground to roof. In the gap below the village the forested mountain face is covered with sandstone talus in blocks up to monument size. Some is saccheroidal, some very hard, and all is very siliceous.

At Broad Top City, a store and a house built many years ago are of light tan sandstone dressed and laid as random ashlar. The stone probably was obtained from float of a Coal Measure sandstone.

Between Dudley and Melrose on the road from Broad Top City to Saxton are banks of beehive coke ovens that have long been idle, and some of which never were fired. They are built of local field or float stone from the Coal Measures, consisting of gray to pink quartzose sandstone. In the Gordon ovens are blocks up to 10 inches thick that are nicely squared and so neatly pointed that the masonry wall has a pleasing appearance. The bank of ovens at Melrose that has never been charged may be demolished some day for building stone.

McConnellstown has one old house at the west end of the village built of the local Helderberg limestone, which is quarried here for flux and for crushed stone. Foundations and retaining walls of sandstone laid as rubble were noted here.

The Trexler bridge over Raystown Branch of Juniata River has abutments and a pier of medium large blocks of gray sandstone and conglomerate possibly derived from float blocks of Pocono sandstone

in the near by gorge of Great Trough Creek. The stone is roughly dressed and appears to be durable.

INDIANA COUNTY.

Indiana County is in the soft coal field in the west-central part of the State and its surface rocks are the Coal Measures. At nine spots only do lower rocks outcrop, and these spots are on anticlines or in gaps, uncovering the Pottsville, Mauch Chunk, and Pocono formations. From these the geologic section extends to the Pittsburgh coal, and so the county contains Kittanning, Freeport, Butler, Mahoning, Saltsburg, and Connellsville sandstones.

The Pocono sandstone is above water level on Conemaugh River where it cuts through Laurel Hill at the southeast corner of the county, and also where the river cuts through Chestnut Ridge below Bolivar.

The Pottsville sandstone occurs at the same two places on Conemaugh River but above the red shale. Also it is exposed where Blacklick Creek cuts through Chestnut Ridge, and it is presumed by the quantity of large blocks of white sandstone strewing the surface that it outcrops along Yellow Creek, on Allen Run, on Two Lick Creek, and on Little Mahoning Creek below Robertsville.

The Loyallhanna (Siliceous) limestone at the top of the Pocono has been quarried for crushed stone in the Chestnut Ridge gap on Conemaugh River but I do not know of the Pocono or Pottsville sandstones having been used in this county. Doubtless the large blocks of hard white sandstone weathered from the outcrops of these members have been used locally for rough masonry.

The Allegheny group outcrops mostly in a belt between Homer and the northeast corner of the county, and the Kittanning, Freeport, and Butler sandstones, where well developed are capable of furnishing dimension stone. None has been produced, however, on a commercial scale, so far as I learned.

The Mahoning sandstone is just above the Upper Freeport coal and is well developed in several areas. It was quarried extensively for locks on the old canal along Conemaugh River, and about 1900 the Kiskiminetas Quarries Company had two large quarries in this sandstone on the west side of the ridge road a mile or more north of Tunnelton. It is so massive that stone suitable for bridge piers and abutments was produced. The Mahoning sandstone is prominent on Chestnut Ridge, on the ridge north of Penn Run and east of Two Lick Creek, on McKee Run, and between Chambersville and Gaibleton.

The Saltsburg sandstone, 200 feet above the Upper Freeport coal, was named from its occurrence at the town on Kiskiminetas River, where it makes a prominent cliff in the river bank. Although well developed at Saltsburg and at Lewisville, at other places in the county it is not always present at its horizon. It occurs at Homer and Edgewood, and on Dias Ridge, and elsewhere, and was once quarried on the road along McCartney Run half a mile west of Reed.

The Morgantown sandstone half way between the Freeport and Pittsburgh coals is usually well developed. It is present in hills west of Homer, in White, Coleman, and Warner hills, and between Grove Chapel and Tanoma in Rayne Township.

Large blocks of massive gray sandstone, possibly Morgantown, are

notable about 10 miles north of Indiana where Route 119 crosses Pine Creek at the Rock Glen gasoline station. This is the only place for 20 miles along this route between Indiana and Punxsutawney where such blocks are seen near the road.

Fifty feet below the Pittsburgh coal a fairly heavy sandstone is seen in Young and Conemaugh townships. This is at the horizon of the Connellsville sandstone and geologically is the highest in the county except the Pittsburgh sandstone, which is not strongly developed here.

All of these sandstones where fairly thick-bedded will make blocks of convenient size for building. They vary in texture from soft and sugary to hard, compact rocks, the same bed changing its character in a short distance. The color of the fresh rock varies also from whitish or light gray and greenish, through buff, brown and red. Weathering commonly changes these rocks to a greenish buff. Because of this common characteristic and the variations in color and hardness, these sandstones resemble each other and can be distinguished principally by their stratigraphic position.

Stone Buildings.

Stone buildings are rare in the rural districts of Indiana County and not numerous in the towns. The Indiana County Court House (1871) is brick, trimmed with buff sandstone said to be Mahoning sandstone. It is not recorded from what quarry it came. Other stone buildings in Indiana are:

Presbyterian Church (1904), a large edifice of Hummelstown brown-stone in rock-face random ashlar. Faces of buttresses and blocks with high relief are stained black, and a few cracks have opened in lintels and column bases, but I saw no sealing.

First United Presbyterian Church (1926) is white granite from Mt. Airy, N. C., with cast stone trim.

Zion Lutheran Church (1923) is Indiana limestone in rock-face random ashlar with trim of the same stone dressed.

First National Bank (1928) has a base of large polished slabs of coarse-grained reddish Minnesota granite, and walls of white marble from Georgia. The interior is Italian marbles. Two other banks are faced with Indiana limestone and the old First National Bank with Ohio sandstone.

At Marchand are two houses of heavy field stone, laid as rubble. It is gray to tan pebble conglomerate, possibly the Pottsville, which is exposed on Little Mahoning Creek below Robertsville. At Clymer are many yellow brick buildings but only one of stone, a new gasoline station at the west end of town. It is local sandstone rubble, and the fresh faces of definite pink and tan are rather attractive. In Homer the first story front of the National Bank and the foundation of the Methodist Episcopal Church are brownstone.

Black Lick shows in the foundation of a church the pretty colors, gray, tan and pink, of the local sandstone, and in the older foundations of a school across the road the effect of weathering on the same stone.

Blairsville has at least two buildings of native stone. The First Methodist Episcopal Church (1888) is Loyallhanna limestone from a

quarry in Chestnut Ridge between Blairsville and Bolivar. The stone, in random ashlar laid with red pointing and red sandstone trim, appears to be in good condition. It has weathered enough to show fine and medium quartz grains in bands, and has turned to a greenish gray color. The jail at Blairsville is native gray sandstone darkened by weathering, First National Bank (1925) is Indiana limestone, and the C. C. Murphy Company building has a brownstone front.

At Saltsburg opposite the railroad station is an old house built of large blocks of gray, yellow, and reddish sandstone, still showing these colors after many decades of exposure to the weather. The First National Bank (1927) is Indiana limestone.

The Saltsburg sandstone is well exposed in a cliff on the south bank of Conemaugh River and under Kiskiminetas School. Massive sandstone 25 feet thick and resting on shale almost overhangs the road along the river bank. It contains shaly lenses and soft spots in which holes have developed.

JEFFERSON COUNTY.

Lying between Clearfield and Clarion counties on the Lakes-to-Sea Highway, is Jefferson County, an area of 666 square miles with 63,000 people. Most of these people are in the southern half of the county, for much of the north half is wilderness too rocky for agriculture and lacking in commercial coal beds.

I know little of the county, having crossed it only on the main east-west highway. A perusal of Platt's report¹ shows that the rocks exposed extend from the Mahoning sandstone above the Upper Freeport coal to the top of the Pocono sandstone. According to him, the Mahoning sandstone, compact, coarse-grained, massive, 30 to 50 feet thick, is in the upland of the southern townships. It shows its presence commonly by an abundance of great boulders, and, 50 years ago, was conspicuous around the heads of ravines at Porter, between Bells Mills and the mouth of Canoe Creek. It scattered great boulders over Gaskill Township and formed the edge of the upland on both sides of Clover Run. The Mahoning sandstone also is notably present along the southern line of Winslow Township around the head of Big Run.

I find no reference to the use of the Mahoning sandstone for building purposes; from the description I assume that large and durable blocks of gray sandstone could be taken from it, and from observation of Coal Measure sandstone I imagine this would weather in a few years to a greenish-tan.

The Freeport sandstone is 30 to 40 feet thick in the hills west of Reynoldsville but its quality is mediocre.

Pratt says more about the Homewood sandstone than any other. It is massive gray sandstone 40 feet thick or more, and commonly strews the surface with great boulders, in some places so abundantly as to make the area a rocky wilderness. The blocks cover the lower slopes in Oliver and Beaver townships, and are abundant around Langville. They make a bluff at Troy, and in Brookville make the hill that rises back of the court house.

In the northern part of the county the Homewood sandstone is a

¹Platt, W. G., Jefferson County; Pennsylvania Second Geological Survey, Report H6. 1881.

striking feature, for it is nearly everywhere massive, coarse-grained, and about 50 feet thick, breaks out in great blocks, makes "rock cities," and wastes large areas, especially in Eldred and Heath townships. Sandy Lick valley in Knox Township and Prior Run in Winslow Township are examples of a region made useless by blocks of Homewood sandstone.

According to Pratt this sandstone was once quarried for building purposes at the side of the Ridgway road directly opposite Port Barnett. So far as I learned the only quarry operating in Jefferson County in 1928 is that of the Falls Creek Sand & Stone Co., which is in the Homewood sandstone. The quarry is $\frac{3}{4}$ mile northwest of Falls Creek Station, and has a face about 3,500 feet long and 40 feet high, all of which is served by a railroad. The rock is blasted by deep churn drill holes, loaded by steam shovel, and hauled to the plant where it is crushed, washed, and ground for silica sand. The stone is somewhat thin bedded above, massive below, a gray quartzose rock, with quartz pebbles the size of wheat kernels in some layers. The more massive beds in the ledge exposed in this quarry are capable of yielding building stone of good quality. They are, however, ground to sand.

The Connoquenessing upper sandstone is described as fine-grained, grayish-white, micaceous, and nearly all of it so irregularly bedded that it weathers to small fragments. It is exposed along Red Bank creek and is also prominent in the northwest corner of the county where it is about 75 feet thick. It is well exposed at Garrisons, is at the foot of the hills at Port Barnett, and at Brookville the railroad tunnels through it.

As only the top of the Pocono sandstone shows above water level on Clarion River for a short distance it is not considered as a building-stone resource in this county.

The Vanport or Ferriferous limestone is found in many parts of the county. It is described as compact, dark gray, of varying thickness, in places very fossiliferous, and easy to quarry. It has been used as agricultural lime but I find no reference to its use or suitability for building stone.

I have only the following notes on the use of building stone in Jefferson County:

The Methodist Episcopal church and Peoples National Bank at Reynoldsville are of Hummelstown brownstone, in good condition.

At Brookville, the Presbyterian church is Hummelstown brownstone, and the Methodist Episcopal church (extra large and fine for a town of 4,000) is of fossiliferous limestone (source not learned). The stones in the base course are 15 inches thick, those above are smaller. The stone is a mass of fragmental shells, with an occasional shell up to 1 inch long. Laid in rock-face, random ashlar this limestone makes a handsome building.

The foundation of the court house at Brookville is regular courses of native sandstone in blocks measuring about 10 by 36 inches. The stone, newly dressed in 1928, is cream to pinkish, with wavy iron stains, and looks well. Probably it is the local Homewood sandstone from some long-forgotten quarry, if not taken from loose boulders. Local sandstone has been used for foundations and retaining walls in this side hill town. The front of the Brookville National Bank is Hummelstown brownstone; the Jefferson National Bank is polished

red granite and the Brookville Title & Trust Company is white granite from outside of the State.

JUNIATA COUNTY.

Juniata lies between Perry and Mifflin counties in the central part of the State. It is a long narrow county of the Vallemont type with parallel narrow ridges of hard sandstone separating wider shale valleys.

The Pennsylvania Railroad and William Penn Highway cross the county near its middle, along the only practicable route in the 50 miles of its length, following the valley of Juniata River. The whole county is rural in aspect, with hamlets scattered about, and a few villages on the Juniata.

The geologic section is the same as for Mifflin County, extending from the Trenton limestone to the Chemung shales. The Trenton limestone underlies a narrow belt in Black Log Valley; Tuscarora and Shade Mountains and Blue Ridge are made of Medina and Oswego sandstones, and the Devonian shales underlie a large area in the east end of the county. The Oriskany sandstone and Helderberg limestone cross the county lengthwise in two courses; one from Thompsettown to Waterloo in a direct course, and one in a zigzag course from Richfield to Port Royal and thence very direct through McCoysville and Peru Mills.

In this county whose industry is mostly agriculture and where some sort of stone for rubble masonry can be obtained within a short distance of almost any building site, there has been no extensive use of stone other than for house, barn, and bridge foundations. Lumber was so cheap in the old days and masons ask such high wages now that stone buildings are not common. In fact, although I have not visited all the county, I might say that stone buildings are rare.

Stone Buildings.

At the extreme eastern tip of Juniata County where West Mahantango Creek empties in the Susquehanna and 200 yards above the highway bridge, is a 2-story stone house with a tablet in the gable inscribed "Diese baum ist baumert in jahr 1792 bei Johan Witmer & Lisabeth Witmer." This house is of black limestone, probably from a nearby outcrop of the Helderberg limestone in the creek bank. The pieces are mostly small and thin, but the masonry is in good condition. The second floor has narrow slits in the stone walls, evidently gun ports for defense against Indians. Here also are a dam and grist mill, and a quarry in the opposite bank of the creek; this probably was the source of the stone in the mill foundation and dam.

These old buildings are on the land of William Libey of Sunbury, who built another house in 1928 nearer the highway bridge. It has a porch, chimney, outdoor swimming pool, and gate posts of whitish flint said to have been found on the hill to the west. The flint is rough, hackly, somewhat varicolored, and makes rather bizarre masonry. This may be Shrivvers chert from the Helderberg formation. Flag walks at this house, made of red and green sandstone, from the hard members of the shaly formations in the vicinity, are well done.

At Richfield, also in the eastern end of the county, the only stone building is the bank, which was built about 1912 of sandstone float from mountain fields a mile north of the village. The stone was

dressed and laid as rock-face, coursed ashlar, and although it has faded somewhat, it is still colorful. This may be Tuscarora sandstone. The trim looks like Hummelstown brownstone. The foundation of the Lutheran Church (1915) is from the same source.

McAlisterville has three or four stone buildings, which is unusual in so small a hamlet. This is due to the fact that on Slim Valley Ridge west of town is an abundance of hard sandstone float that is suited to building purposes. This ridge may be the Tuscarora sandstone brought up in midst of a broad belt of Martinsburg shale by a minor anticline. Leastwise the ridge is strewn with white, gray, light tan, and reddish sandstone that dresses well to ashlar and makes attractive masonry, owing to the light, warm color effect. The bank and three residences have been built recently of this local stone, and make a pleasing appearance. In this small community the freshly dressed stone should retain its color for many years. Rubble foundations of farm buildings in this vicinity are of this stone but some look rather piebald,—dark and light stones mixed, because they were used as found and not dressed to fresh faces.

I have no record of stone buildings in the river towns, Thompsonstown, Mexico, Port Royal, and Millintown, and have not visited the large part of the county that lies south and west of the river.

LACKAWANNA COUNTY.

Only three counties, Allegheny, Delaware, and Philadelphia, have denser population than Lackawanna. With 635 people per square mile, this means large public buildings and naturally many in which stone is a main structural material. The population is very much concentrated in the Lackawanna Valley, which is also part of the Northern Anthracite Field. This field extends across the county from Old Forge through Scranton, Archbald, and Carbondale to Forest City.

The Coal Measures are flanked on both sides by the Pottsville conglomerate, Mauch Chunk red shale and Pocono sandstone, which together, being more resistant than the Coal Measures, make the Bald Mountains on the west and the Moosic Mountains on the east. All that part of the county west of the Bald Mountains is underlain by Catskill red shale and sandstone beds, and that east of the Wyoming Valley is all Pocono sandstone except where the Catskill beds are exposed in some of the lower country.

The native stone used for building is mostly from the Pocono, Pottsville, and Mauch Chunk formations; in the western part of the county Catskill sandstone and glacial boulders have been used. The Pocono is coarse-grained sandstone and fine conglomerate; the Pottsville is coarse sandstone and conglomerate with white quartz pebbles up to an inch in diameter. Both formations yield stone of varying tints from gray through tan, buff, and iron stained, to reddish. The Mauch Chunk red sandstone is quartzitic in places and makes a more durable building stone than the Triassic brownstone, which looks somewhat like it.

Carbondale. The Methodist Episcopal Church (1892) and the American Hotel (1893) are faced with Pocono sandstone from the ridge just north of Forest City, in the southeast corner of Susquehanna County. The hotel front in rock-face, coursed ashlar is light

gray, like Indiana limestone, and very fresh-looking for having been cleaned only once since it was built. Hand-carved scrolls and human faces on several panels indicate the suitability of this stone for ornamentation.

The First M. E. Church (1892) is in rock-face, random ashlar up to 10 inches thick, all weathered to an even gray and probably is Pocono sandstone from near by. Some blocks have a faint tan tint, and some carry a few pebbles. The water table, lintels, sills, and door quoins are pink sandstone, possibly selected for color from the same quarry. All of the stone appears to be in good condition and durable. The principal soiling is on the window sills and under them.

The base of the High School (1916) is Triassic brownstone, fairly clean, but several blocks, including two window caps, are cracked.

Berean Baptist Church (1888) is gray sandstone and fine conglomerate of a gray tone, but now weather-stained. It may have come from the quarry on Fall Brook.

About 2 miles northwest of the square at Carbondale the Pottsville makes a ravine and waterfall on Fall Brook. Just above the fall at road level is a quarry that was operated for crushed stone when the road to Dumdaff was improved. The upper ledges in the quarry face are mostly conglomerate with half-inch pebbles. Some of the conglomerate has white matrix and some black. The lower ledges are bluestone. The joints are much iron-stained. Another quarry high above the east side of the road just above here has supplied much rubble and some ashlar to Carbondale.

The West Side Catholic Church by the bridge over the railroad has a front of gray sandstone that may have come from Forest City. It was built about 1915. The doors are framed in Indiana limestone.

The Carbondale Miners & Mechanics Savings Bank (1914) and the First National Bank (1928) are faced with Indiana limestone on granite base. The Liberty Discount & Savings Bank is Indiana limestone on a base that looks like the white granite from Mt. Airy, North Carolina.

Scranton. Building stone was being quarried at two localities near Scranton in 1930, one at Nay Aug park on the east side of the city, and the other on West or Bald Mountain. Peter Stipp & Sons have worked a large quarry at Colfax Avenue and Pine Street (Nau Aug park) in blue sandstone near the base of the Coal Measures for crushed stone for many years. Incidentally rubble has been sold for foundations and ashlar has been made from this stone for some jobs. It is known to builders as Petersburg bluestone, so-called for its color and the part of the city in which the quarry is located. The quarry has been worked back about 500 feet from the outcrop and so has a long face. The sandstone exposed in the 25-foot face is irregularly bedded; the upper beds are medium-grained and the lower ones coarse to pebbly. The Pennsylvania Oral School for the Deaf was built of bluestone ashlar from the Stipp quarry.

Two miles out the turnpike from Hyde Park over West Mountain the Pocono sandstone has been quarried extensively. Two large quarries on either side of the stream cannot be overlooked by the passerby. One has been idle for a long time but that on the west side of the road is worked by the owner, Joe Godino, with one helper. Development has been along the outcrop about 300 feet in beds dipping down the mountain 15° , and back from the outcrop 50 feet or more. Lifts



Fig. 95. Stipp's sandstone quarry, Scranton, Lackawanna County.

are heavier now that the quarry is back from the crop and blocks 10 inches thick can be taken. About 30 feet of beds have been worked, and there is very little overburden. The stone is usually referred to as yellow, although tan or buff may be more exact. Some of it is streaked with brown.

The Lackawanna County Court House, completed in 1884, in buff sandstone rock-faced random ashlar is now very dark with coal soot, but originally was a light yellowish color. Cleaning with sandblast would restore it to the original light color. The stone is said to have come from several quarries on West Mountain.

The stone in the Municipal Building (1888) is from the same source and that making the high wall around the county jail also looks like West Mountain stone. Both of these structures are much soiled now, especially the window sills and blocks having highest relief.

Three upper stories of Central High School (1896) are West Mountain yellow sandstone in rock-face ashlar now rather dirty. The windows are framed in the same stone dressed smooth, which has not caught so much dirt, and gives a poor effect. An addition to this building constructed in the same manner is not yet so dirty and the contrast between dressed and rock-face blocks is less.

The Technical High School (1904) is of yellow sandstone from West Mountain now soiled, but not so much as the older buildings. The new part (1930) is faced with fresh stone from the same quarry and shows variegated light reddish and gray, besides the usual yellow. The first floor is Indiana limestone.

Another large edifice of West Mountain stone is the First Methodist Episcopal Church (1892) commonly called Elm Park Church, and Sunday School building (1927). Here also one can see the effect of city atmosphere and smoke for 35 years contrasted with fresh

faces. This edifice is on a bluestone base, with bluestone quoins over windows of the upper story. Sills and lintels are Indiana limestone. The only defects observed are in the bluestone. An interesting feature of this building is the ornamentation of the door to the church office. On each side are three columns, one twisted, one vertical fluted, and one in diamond tracery; and each column of a set has a different capital.

St. John's Lutheran Church (1885) was built of yellow sandstone from West Mountain when the quarries had not advanced far from the outcrop and yet the stone in this edifice looks perfectly sound, except the bluestone steps, which are sealing. The trim is pinkish gray sandstone also of local origin.

Buildings in Scranton constructed largely of local sandstone include the large Roman Catholic Church of the Nativity at Orchard Street and South Webster Avenue, which is pinkish sandstone and fine pebble conglomerate in rock-face, random ashlar. The stone is fairly clean and the pinkish color is easily discerned. Even the small columns, carved capitols, and fluted door quoins are of this stone, which is said to have come from the mountain west of Peckville and to be called Muldoon pink. The base is fine-grained green sandstone, but whether from Susquehanna County or from Ohio was not learned.

The Hudson Coal Company building, formerly the main building of the International Correspondence School, is pink Pocono (?) sandstone from the mountains near Peckville. It was referred to in the specifications for the building as "Lackawanna pink granite," probably because it is very hard and durable. The foundation of this building is Nicholson bluestone in massive blocks.

Hotel Jermyn (1895) is faced with Pocono sandstone from Forest City in massive, rock-face, coursed ashlar. The whole effect is gray, although there is a general increase in the amount of discoloration from the top down. The native sandstone is now the same shade as the Indiana limestone panels. Sandstone from the Forest City quarry was used also in the First National (Traders) Bank from the third to the sixth floor.

The Scranton Electric Company building is faced with pink Tennessee marble for two floors, with Indiana limestone above. Emanuel Baptist Church (1909) is brownstone, possibly from Longmeadow, Massachusetts. The Dime Bank building is Indiana limestone with Longmeadow (?) brownstone above. The Glen Alden Coal Company building is Indiana limestone, as is also the Masonic Temple (1928) with its fine carving over the main door.

Much of the bluestone curbing, steps, and coping used in Scranton is said to have come from the vicinity of Nicholson, Susquehanna County.

Olyphant. A church in Olyphant was being built in 1930 of yellow sandstone from the West Mountain quarry near Hyde Park.

Archbald. A bank in this town is said to be faced with sandstone from the Forest City quarry.

LANCASTER COUNTY.

Lancaster County is in the southeastern part of the State and is sometimes known as the Garden Spot of America. Its western boundary is Susquehanna River and its southern is on the Maryland line.

Tobacco is a big crop in this county and Lancaster, the county seat, is also the home of the Hamilton watch and Armstrong linoleum.

The southern part of the county is underlain largely by schist, with patches of serpentine and slate near the Maryland line. Limestone occupies the great central valley, with Chickies quartzite forming some of the hills. Across the northern part of the county Triassic red shale and sandstone is the country rock. Diabase or trap dikes occur in these beds and a long one extends from Peach Bottom Station through Quarryville to Pequea.

In all that part of the county underlain by schists, which is most of the region south of Kinzers, Quarryville and Safe Harbor, stone buildings are few. The thin-bedded Peters Creek micaceous quartzite, chlorite schist, and serpentine have been used in farm buildings, but the masonry is so rough that the stone houses have been white-washed or given an exterior coat of plaster to disguise or conceal the rough masonry.

In the hill south of Mountville a greenish-gray sparkling phyllite has been quarried in the Antietam formation by A. R. Shaffer for building stone. The rock breaks readily from the quarry along a nearly vertical schistosity but does not dress readily to a smooth face across the bedding. It makes a pleasing building stone if well dressed and laid.

A somewhat similar stone has been quarried on the river road one mile below Columbia. The old quarry parallels the river road for 400 feet and has a face up to 100 feet high, but it appears to have been idle for many years except in the middle where about 2 cars of rough stone were blasted out in 1927. This stone is used for cellar walls and backing. A mason told me it will not dress satisfactorily because it splinters when broken across the bedding. The stone looks like argillaceous limestone.

Micaceous crystalline limestone containing abundant small pyrite cubes was used for building a house, bridge, and mill one mile below Washingtonboro. Sander's mill, as it is called, was built by Jacob Witmer in 1832, of stone said to have been taken from the river. One block is 11 feet long and 13 inches square; one window cap is about 5 feet long and 18 inches high; other blocks are 14 to 18 by 50 inches and smaller. Some of the stones that are laid on edge can be sealed slightly but they have not spalled noticeably. This masonry looks ready for another century of service.

In Lancaster County at least 80 limestone quarries have been operated in recent years. These are mostly producing crushed stone for roads and concrete, or are operated in connection with lime kilns. This number does not include many quarries that have long been idle. These quarries of course could supply rough building stone of the kind so common in the Chester and Cumberland valleys, but very few of them do because about the only demand is for rubble for foundations, and this is rapidly decreasing because of the use of poured concrete, cinder blocks, tile, etc. for foundations.

Since 1925, Walter B. Kendig opened a quarry in the Conestoga limestone just east of Lancaster for building stone. It is in beds striking northeast and dipping $SE.75^{\circ}$. This banded blue crystalline limestone with slickensided slaty partings weathers to light gray. A quarry near by that supplied stone for the old City Mill and adjoining houses has been operated lately by J. M. Biemer. The old



Fig. 96. Pennsylvania Railroad bridge over Conestoga Creek, Lancaster. Built of ribbed Conestoga limestone from quarry near by.



Fig. 97. Frantz grist mill on Little Conestoga Creek 1 mile west of Millersville, Lancaster County. Built of local limestone.

Factory Bridge over Conestoga Creek at the southeast corner of the city is an example of the durability of Conestoga limestone under difficult conditions. Here and in other bridges the limestone looks as serviceable as when placed several decades ago.

A. H. Burkholder has been quarrying limestone at Quarryville for some years, first to burn into lime and later for crushed stone. He gets out rough building stone on demand and the Memorial M. E. Church at Quarryville is built of limestone from his quarry. A quarry $\frac{1}{2}$ mile west of Martindale on the north bank of Conestoga Creek operated by David Burkholder for crushed stone is in straight-bedded blue limestone that has been used considerably for houses and fences in that vicinity. Limestone was used more for building in earlier days than now, especially for grist mills and farm buildings.

Chickies quartzite occurs in the ridge east of Marietta and in Welsh Mountain in the eastern part of the county. It was formerly quarried for foundations, steps, sills, and rarely for whole buildings. Examples of its use for foundations may be seen in Marietta. This stone is quarried at Chickies Rock and crushed for refractory lining of furnaces. It is said not to be suitable for building stone (except in rubble walls) because it is much iron-stained and joints are not vertical to the bedding. It will not dress readily and when a block is dressed neatly it breaks along some invisible cleavage with the last blow of the hammer.

A quartzite quarry was opened in 1925 at Oetararo churches 5 miles east of Quarryville by W. B. Aierstuek, Lancaster. The location known as Greentree quarry is on Meetinghouse Creek 400 yards north of the Valley Road. Here the strata strike N.E. and dip SE 45° . When seen in 1929 the quarry, opened in weathered rock, was



Fig. 98. Church of God (1925), Lancaster, built of Chickies quartzite from Greentree.

getting into harder and heavier-bedded micaceous quartzite. Some faces glisten with white mica, some are distinctly banded, some clean and light colored, and others are stained brown. Door stones and sills are taken as well as rough building stone. A building of this stone showing the slight effect of weathering is the Octararo Presbyterian Church built before 1800 on the Valley Road just west of Meetinghouse Creek. The masonry is a curious mixture of angular and squared, rough and smooth-faced blocks. The front of the church was remodeled in 1913, and a coat of rough cast has been removed from the old walls.

On the upper side of the road is the United Presbyterian Church, built in 1754, and rebuilt in 1848. It is no longer used for meetings. The walls are Chickies quartzite surface stone laid as rubble and covered with rough cast. At the next road corners on the east is the old Green Tree Inn, built of the same stone in 1765, now a private residence and the stone work entirely concealed by plaster. The large barn across the road is all stone, revealed by the plaster coming off.

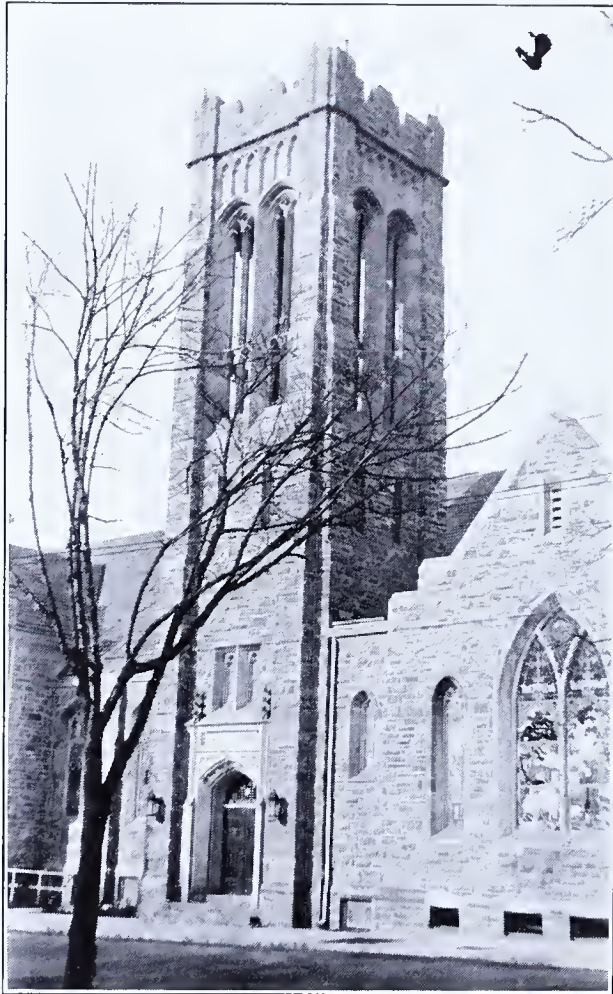


Fig. 99. St. Johns Evangelical Lutheran Church (1927), Columbia, Lancaster County. Built of Chickies quartzite from Greentree.

These buildings are in good condition, as are 3 or 4 old stone houses up the run from the road corners. Modern examples of the same stone from the new quarry are the Church of God (1925) opposite the Girls' High School, East Chestnut and Charlotte Streets, Lancaster, and St. John's Evangelical Lutheran Church (1927) at Columbia. In the churches done in natural face random ashlar a noticeable feature is that many blocks have oblique, rather than square ends. This is because jointing is not at right angles to the bedding in the quarry. The blocks are rarely over 7 inches thick or 2 feet long. Some are yellowish-brown with iron stain, some glisten with mica. The new masonry is pleasing in appearance. It remains to be seen how soon it will be discolored in city atmosphere.

The northern part of Lancaster County is underlain by Triassic sediments intruded by trap dikes. Trap weathers to more or less rounded boulders, with which the surface is strewn. These may furnish building material, but the rock on fresh fracture is so dark that it is little used for this purpose. Just north of Terre Hill are several fences built of trap boulders, unless this material has been crushed for road metal. Between Blue Ball and Churchtown where trap is abundant it makes the walls of some farm buildings, some of which are whitewashed because the stone is too dark. On the river road near Falmouth an old mill built of gray sandstone has large blocks of trap in the corners, contrasting in color with the rest of the wall. On the road north of Falmouth are numerous fences of trap gathered from the fields, and some buildings. The rock is either very dark or iron stained and the combination in rubble masonry gives a somber and patchy effect. One mile northeast of Falmouth along a small run is the locality known as Governor's Stables, a considerable area of huge blocks and outcrop of trap.

At Collins Station in the western end of the county between Falmouth and Bainbridge diabase was formerly quarried extensively. Stone similar to this, if not from this quarry, was used in the foun-



Fig. 100. Trap rock at Governor's Stables, near Falmouth, Lancaster County.

dation of the Post Office at Harrisburg and in the Soldiers Monument at Second and State Streets, Harrisburg.

The Triassic beds include brown, red, pink, gray, and greenish sandstone, and conglomerate with white quartz pebbles up to 1 inch in diameter. In some places these must occur close together for in Churchtown the Caernarvon Academy (1854) contains all of these. Perhaps the material was float or field stone, and not quarried. The use of so many different colors gives a piebald effect that is far from pleasing. In the arch over the main window red and light-colored cut blocks alternate, a further evidence of poor taste. All of the stone in this building appears to be in good condition, including the coarsest conglomerate. The modern Methodist Episcopal Church in Churchtown is all one tone brownstone in squared blocks and in much better taste. Presumably this stone came from the red beds that outcrop just north of the village.

Stone buildings are rare in Ephrata. Two on the main street have serpentine fronts, and one store that looks as if built of trap is sandstone painted.

The pumping station of the Lebanon water system on Hammer Creek 2 miles west of Brickerville was built in 1900 of Triassic sandstone obtained near by. The general tone is brown but on close examination one finds that the walls contain red, purple, rusty and gray sandstone and red conglomerate. The walls are rubble work with selected light pink sandstone trim.

Serpentine occurs in the southern end of the county. A quarry half a mile southwest of Union or Colerain on the bank of Gables Run was opened by A. H. Burkholder of Quarryville for road metal. It has a crescentic face 150 feet long and 10 to 30 feet high. The serpentine ranges from dark to light green, from massive with irregular fracture to thin shaly stuff, from hard to soft, and is much and irregularly jointed. The hard, massive serpentine would do for building stone if used as rubble, but would be hard to dress to regular shape.

On the west bank of Octararo Creek about $\frac{3}{4}$ mile north of the State line Walter Geiger is operating a quarry in serpentine. This quarry was opened originally for road metal in 1924. The stone is shot down, crushed, screened, and sacked. The product of one ledge is dark green serpentine, known as oak leaf granules, and of another ledge is light green, called emerald granules. The granules are used in terrazzo floors. Serpentine rubble for building stone could be produced here.

Hard greenstone or serpentine quarried close by was used for building the Baptist Meeting House in 1808 on the Quarryville-Conowingo Road a mile north of the State line. This one-story building is mostly rubble masonry, though the front and end toward the road are smoother than the other walls. Some of the rubble is massive greenstone and some is like chlorite schist. The corner quoins are micaceous quartzite from across Conowingo Creek. No deterioration is noticeable in the stone.

At Cardiff, Maryland, the deep quarry of the Cardiff Green Marble Company, producing "Cardiff green marble," is only a few rods over the State line. This is a hard, emerald-green serpentine that takes a good polish and is very suitable for interior decoration. It is used also in store fronts under the show windows. If this hard phase of the serpentine could be traced over the line into Lan-

eastern County or a similar occurrence found elsewhere in the serpentine areas of southeastern Pennsylvania, its development would be worth giving careful consideration.

Old buildings and others.

Many old buildings not only are still standing but are in use in Lancaster County. Right on the square in Lancaster is the City Hall, a three-story brick structure with a limestone foundation. This limestone, painted blue, is in excellent condition. It was laid in 1795, and so antedates by four years the Witmer bridge which carries Lincoln Highway across Conestoga River at the east edge of the city. This bridge, built by Abraham Witmer in 1799-1800 is mostly fairly-well shaped blocks of native blue limestone. The nine arches are outlined with light-colored Triassic sandstone.

The County Court House in Lancaster is not old (1852) but it exhibits in its lower walls and in the fluted 7-drum pillars the usual effect of exposure on the Triassic conglomerate, the pitting by loss of pebbles. In 1928 two one-story wings were added in front and all masonry was cleaned by sandblasting. The colors of the fresh stone are gray, pink, pale tan, and reddish. This sandstone and conglomerate were taken on the mountain north of Penryn in the northern part of the county and the same source, loose blocks in the woods, supplied the stone for the additions. It was shipped in rough blocks to Baltimore to be sawed and dressed. It is reported that because of the friability only one car of dressed stone was obtained from three cars of rough blocks. The principal construction is ashlar in 11-inch courses of blocks up to 30 inches long.

The county jail in Lancaster (1852) and the trim in the brick main building at Franklin and Marshall College are Triassic sandstone from the same source.

According to tourist circulars the oldest house in Lancaster County is at Willow Street, 5 miles south of Lancaster. It is on the farm of David Hoover and was built by Christian Herr in 1719; at least the stone door lintel bears that date. The foundation rests on a ledge of soft dark tan sandstone, from which the rubble for the building may have been derived. The same stone in the foundation of the adjoining large modern barn was red and green hues. It is a loose-grained silica sand so little cemented or so deeply weathered that nails can be driven into it. Evidently it is easily dressed for windows are set in grooved stone frames. In spite of the softness of the stone the building has stood more than 200 years. The roughcast that once covered and protected the masonry has fallen off, and the building is now rapidly deteriorating for lack of care.

Another old building is the two and one-half story limestone farm house on the property of John F. Weaver near Lampeter. It is said to have been built about 1700 but is in a fine state of preservation, the walls well pointed, and it is occupied as a dwelling. The native limestone has an even gray tone, and looks perfectly sound. In Lampeter a fine limestone building is the Eagle Hotel "built by Samuel and Anna Miller 1815." The native limestone rubble is an even, dark gray tone.

The Marietta Presbyterian Church, built of brick in 1853, has a front of micaceous white marble that was added in 1898 and 1909. This marble came from Avondale, Chester County, and besides being

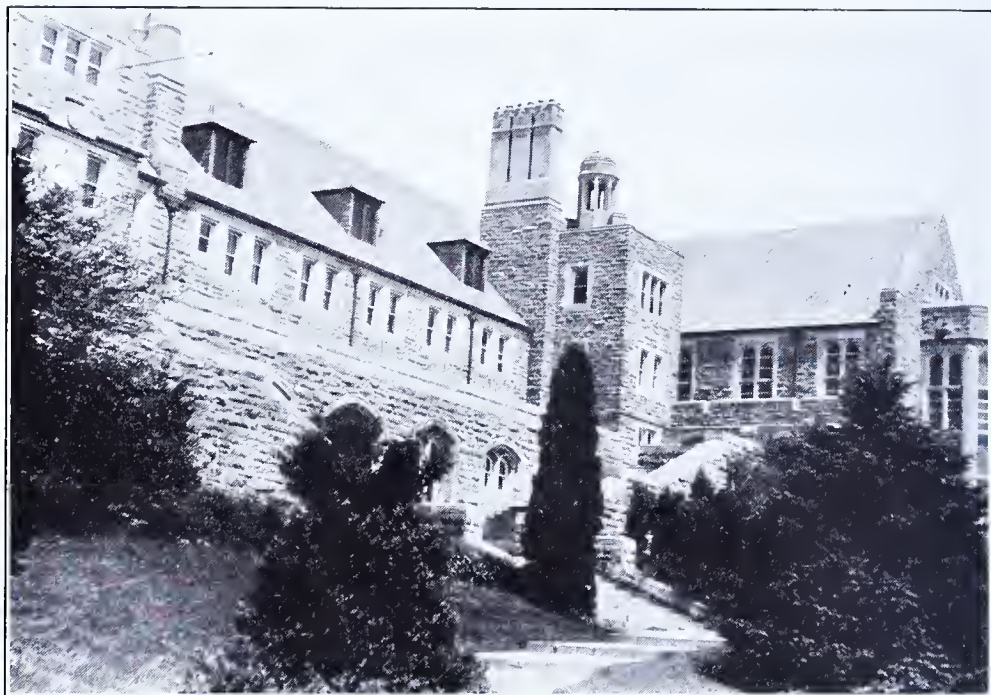


Fig. 101. Masonic Home, Elizabethtown, built of granite gneiss from Holmesburg, Philadelphia County.



Fig. 102. Granite gneiss from Holmesburg, in Masonic Home, Elizabethtown, Lancaster County.

rock-faced, coursed ashlar, includes carved angel heads and baskets of fruit.

Among the old mills built of limestone are Schochs mill $2\frac{1}{2}$ miles west of Marietta, a mill on Donegal Creek $2\frac{1}{2}$ miles east of Maytown built by Henry Share 1804, and Amways mill on Chickies Creek east of Marietta "built by Henry Share and Mary his wife 1814." All are blue-gray limestone, with a few blocks weathered to light tan.

Donegal Presbyterian Church (1740) is another old building of blue-gray limestone. It is 3 miles west of Mount Joy and founded on limestone bedrock which outcrops in the church yard and at the adjacent big spring. The church walls are limestone rubble coated with rough cast. The edifice is in good repair and still in use for regular services.

The 4-arch stone bridge of the Pennsylvania Railroad over Cone-stoga Creek just south of the Lancaster Water works is built of Cone-stoga limestone from the Traction Company quarry northeast of Lancaster and east of Rossmere. The blocks are up to $5 \times 2 \times 1\frac{1}{2}$ feet.

A notable group of stone buildings in this county is the Masonic Home at Elizabethtown, where several large structures of the same architectural style have been built of granite gneiss from Holmesburg, Philadelphia County. The stone is rock-face random ashlar and gives a feeling of dignity and permanence.

LAWRENCE COUNTY.

The middle one of the counties bordering on Ohio is Lawrence, which lies between Mercer and Beaver counties. It was named for James Lawrence, captain in the memorable battle with the British on Lake Erie. New Castle, a city of 50,000, is in the middle of the county on Shenango River just above where it joins the Mahoning to form Beaver River on Big Beaver. With a population of more than 97,000 in 360 square miles, or about 270 persons per square mile, and with an abundance of stone suitable for building well distributed, the use of local building stone at present, nevertheless, is small in this county.

In 1928, only one quarry was producing building stone, so far as I learned. This was the sandstone quarry of the W. B. Martin Co., (710 Chamber of Commerce Bldg., Pittsburgh) located at Neshannock Falls in Wilmington Township. The site is a narrow, rock-walled valley where the creek cuts through Pottsville sandstone and descends rapidly over the lower member. In the cliffs high above the creek, sandstone has been quarried extensively in both banks. An abandoned quarry on the south bank is several hundred feet long with a face 40 to 50 feet high. Present operations are on the north bank. It was opened about 1900, by Drake & Stratton, Pittsburgh contractors, to get material for railroad culverts and retaining walls. Some of the big stone wall along the Pennsylvania Railroad at Birmingham, Huntingdon County, came from this quarry. In the course of 25 years the cliff has been quarried for 500 yards. Where the Martin Co. was working in 1928 it was necessary to strip about 16 feet of rock, from which there was little salvage, to uncover the good stone, a rather massive bed 24 feet thick. Bedding planes in the more massive part are not everywhere

parallel and the larger blocks broken out are rarely rectangular. The formation is the Upper Connoquenessing sandstone which here is medium-grained, grayish-white rock, slightly stained with iron oxide, and well adapted for heavy masonry. Blocks are lifted by derrick from the quarry face to a car which carries them to the dressing floor at the railroad spur. Here a steam hoist sets the blocks where needed on the ground or in a railroad car. In recent years the product of the quarry has been used mostly in schools and churches. Examples are the Sacred Heart Church and Schenley High School, Pittsburgh, and the new (1928) main building of Westminster College at New Wilmington, Lawrence County. In this latter building, which is 3 miles from the quarry, the gray silica sandstone with some iron-staining makes a pleasing appearance. Indiana limestone was used for trim, but the doorway in which all native stone was used is, to some minds, particularly good. The boys' dormitory and the chapel (1924) at Westminster College are of gray and brown sandstone derived from field stone and from a small quarry north of town. The contrast in colors in the blocks used in the dormitory is particularly striking.

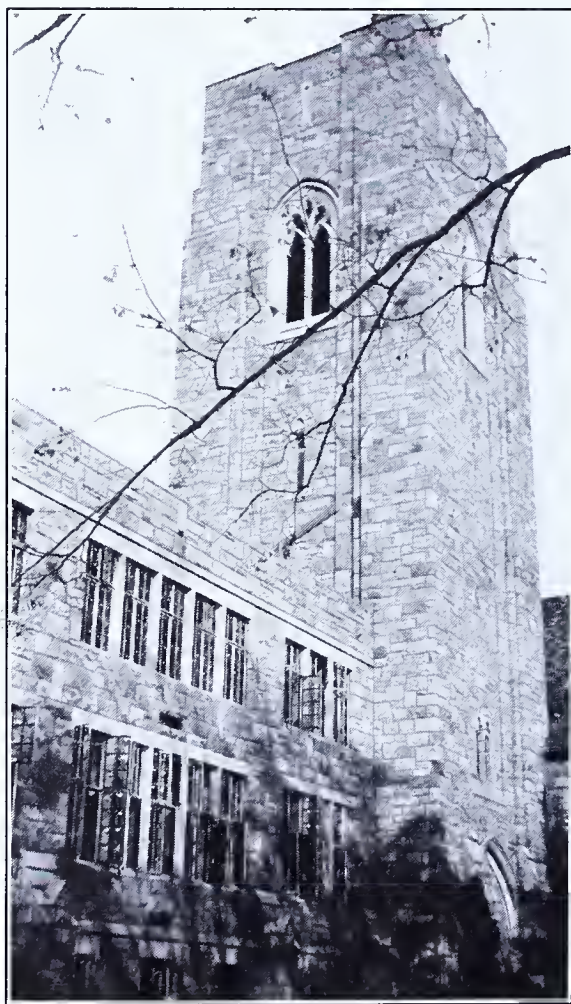


Fig. 103. Sandstone from Neshannock Falls used in Westminster College, New Wilmington, Lawrence County.

In 1929 a sandstone quarry 1 mile east of Ellwood City on the bank of Connoquenessing Creek opposite Wurttemberg was being operated for curbstone. C. T. Eastburn of Yardley is said to have bought the quarry from the Circle Lumber Co. in 1928. It is at least 30 years old but had long been idle. In the summer of 1929 40 men were em-



Fig. 104. Quarry in Homewood sandstone at Wurttemberg, Lawrence County. Operated by C. T. Eastburn.

ployed here on a single product, curbstone for the Pittsburgh market. Three masts operated by steam moved the blocks in the quarry, and at the dressing yard on the railroad siding were five dressing tools operated by compressed air from a Sullivan portable gasoline compressor.

The curbing, which is dressed 6 by 22 inches and random length, is mostly tan, but includes some gray and blue sandstone, composed of clear, even-sized grains of quartz. The gray stone is said to be much harder than the deep buff. This is the Homewood sandstone, which here is about 60 feet thick. It could well be used for building stone and for heavy bridge masonry. The Shriners' Temple, Trenton, N. J., is faced with stone from this quarry.

Information about other building stone resources is gleaned from White's report on Lawrence County.¹

The rock strata exposed in this county extend from the Buffalo sandstone above the Freeport coal to the base of the Pottsville series. The Buffalo sandstone varies from a hard, coarse brownish sandstone to a quartz pebble conglomerate and occurs only in the highest ridges in Perry Township. Here the ledge makes a steep bluff, at and below which the surface is strewn with large blocks. This stone is durable and might serve for rural construction but its color is not attractive.

The Upper Freeport or Butler sandstone is a coarse, hard, grayish-white rock sufficiently massive to make sizeable blocks. It outcrops in a ledge from Wampum south to the Beaver County line.

The Lower Freeport sandstone is mentioned by White as having been

¹ White, I. C., The geology of Lawrence County: Pa. Second Geol. Survey, Report QQ, 1879.

quarried at two places in North Beaver Township. This was 50 years ago and the openings were merely for very local use, if one may judge from the statement that the builders used it simply because nothing else was obtainable. The sandstone here is about 60 feet thick, is hard, streaked and specked with iron oxide, and furnished building stone from its more massive upper layers and flagging from the lower layers. One quarry was worked by a Mr. Woods $2\frac{1}{2}$ miles southwest of Mt. Jackson and the other by Mr. Sauer near the Ohio line.

The Kittanning sandstone is generally a very hard and coarse, grayish-brown rock, in places 20 to 30 feet thick, but inclined to be flaggy. It probably weathers to a dark tan, like other Coal Measure sandstones. I do not know of a quarry in it.

The Homewood sandstone at the top of the Pottsville series is thick in some places and thin in others, but is usually massive and coarse-grained or conglomerate. It ranges up to 60 or more feet thick but in places becomes so thin-bedded or shaly as to be inconspicuous. Where thick and massive it is a cliff maker and has been opened along Beaver River from Beaver Falls to Wampum where it underlies the broad flat, and in Edwards and Hickory Run. Its color is gray to yellow, and where massive and free from pebbles it makes good building stone. It is of no account near Newport but at the falls of Big Run near New Castle it is 30 to 40 feet thick, and massive bedded, as it is also along Neshannock Creek. It is well developed on Slippery Rock Creek in the southeastern part of the county.

The Upper Connoquenessing sandstone in places is almost continuous with the Homewood sandstone; elsewhere they may be well separated by the Mercer group. It averages about 40 feet thick but has a wide range, between 5 and 80 feet. It is massive, coarse-grained sandstone where it is not shaly or pebbly, and has been quarried in several places where the stone is suitable for building, and where the bedding is not too irregular. Quarries on this bed along Connoquenessing Creek where it is the upper wall rock, and at Rock Point, have long been idle. On the lower part of Hickory Run its massive ledges make a rocky ravine and near where the railroad crosses the run, according to White, a culvert was built of this stone, which is coarse, white and pebbly.

The Lower Connoquenessing sandstone is a coarse-grained rock, often containing iron concretions and usually so stained or streaked with iron oxide, or of such a brownish color that it is not a desirable building stone. It outcrops along Connoquenessing Creek near Ellwood City, is exposed in the right bank of Shenango River at New Castle, and makes vertical cliffs for a long distance on Neshannock Creek.

Limestone is abundant from Ellwood City to New Castle and Bessemer in the Vanport bed which ranges up to 22 feet thick. The upper part of the bed is gray and the lower part blue. This stone is brittle and breaks with irregular fracture so it could not be easily dressed for building stone. It could be used however, for foundations and other rough construction. It is quarried extensively for portland cement and crushed stone for use in concrete.

LEBANON COUNTY.

The sequence of rock formations in Lebanon County repeats that of Dauphin County from the southern boundary to Stony Mountain. The hills south of the road through Campbellstown, Cornwall and

Schaefferstown are mostly sandstone of Triassic age intruded with trap. The limestone valley 3 to 7 miles wide has its northern limit on the outskirts of Palmyra, Annville, Lebanon, and Myerstown. The slightly higher country extending from this line to Kittatinny Mountain is underlain by the Martinsburg shale formation, which includes some hard sandstone. Kittatinny Mountain owes its prominence to the Medina sandstone, Second Mountain to the Pocono sandstone, and Stony Mountain to the Pottsville conglomerate. Oriskany sandstone occurs on the north side of Kittatinny Mountain and a fold in the structure retained the Medina sandstone in Little Mountain which lies between Monroe Valley and Fredericksburg. Trap dikes and quartzite occur in Bunker Hill and Mt. Ararat south of Jonestown.

Limestone has been used for building purposes more than any other rock in the county because it underlies, outcrops and is quarried in the most populous area, the Lebanon Valley. Through the length and breadth of this valley one sees churches, schools, farm houses, barns,



Fig. 105. Limestone bridge over Quittapahilla Creek, Annville, Lebanon County.

town residences, banks, hotels and bridges built of the native limestone. All of those that have been up for more than a few years are weathered to a light gray of pleasing appearance. At least this is the general effect. On close examination it will be noticed in some buildings that certain blocks have a slightly pink color, due perhaps to the presence of a small amount of iron, and others contain either a cherty substance or muddy layers which have weathered to a brown. Along the south side of the Lebanon Valley, in proximity to the Triassic beds, some of the limestone buildings are ornamented or trimmed with brownstone corners, and in or near South Mountain brownstone is the common building stone. The mountain stone at the northern border of the county is little used because it is in a rather thinly settled farming district.

Beginning at the southern part of the county, this description of some of the things I have observed will proceed generally to the north. The only brownstone quarry that has been worked in recent years is that on the north side of the railroad at Mt. Gretna. This quarry is comparatively small and is now flooded. When in operation the product was sawed and worked to dimension stone. In later years the brownstone not suitable for building stone has been ground for sand to use in making sand-lime brick. The most notable brownstone buildings in the southern part of the county are at Cornwall. Here the principal buildings of the Bethlehem Mines Corporation are of excellent chocolate-colored brownstone free from quartz and shale pebbles, and of a nonfading quality. Some of the buildings were designed by a very competent architect and bring out the best that is in the stone. The railroad station at Cornwall is an example of such architecture, while the Episcopal Church near by, which is limestone walls and brownstone trim is a much less attractive building. The tenant



Fig. 106. Railroad station at Cornwall, built of brownstone.

houses built by the mining company many years ago for the use of its employes are notable because of the very durable construction and suggestion of an English village. Some houses are all limestone, others all brownstone, and some are one of these rocks and trimmed with the other. Although they have been occupied by tenants for many decades the masonry appears to be in excellent condition. The large school house at Cornwall built in 1928 is of limestone from the Millard quarry near Myerstown.

At Colebrook an old inn, a mill, and several houses are of brownstone rubble from some nearby quarry. A quarry at Schaefferstown operated by A. B. Horst has supplied the limestone for churches and other buildings in the village, and also for St. Luke's Lutheran Church, at Seventh and Leaman Streets, in Lebanon. The quarry, which is beside

the highway in the village, is now about 52 feet deep, and 100 feet across. This nearly circular excavation has natural drainage in the bottom to an underground water course. The present product is mainly crushed stone for highway construction. Schaefferstown has several rather old buildings, including the hotel and houses on the square, built of this native limestone, and also a brownstone bank.



Fig. 107. Mine company houses at Cornwall, Lebanon County, built of limestone, with brownstone trim.

South Mountain in Mill Creek Township, owes its prominence in part to the weather-resisting quality of a quartzite of Cambrian age. In the north face of the mountain near Newmanstown a quarry is operated by E. J. Lavino and Company to provide silica for the refractory brick plant. The quarry has a face about 300 feet long and 100 feet high, in beds dipping N. 60°. Both the hard quartzite and the white friable rock are sent to the brick plant. This hard quartzite has been used occasionally along the mountain for building purposes in house and barn foundations.

An interesting old house in this vicinity, known as Zellers Fort is on the farm of David Erb, on Mill Creek about three-fourths of a mile south of Sheridan. This house presumably built of limestone is all plastered or heavily whitewashed, but bears a tablet inscribed, "Heinrich Zellar, 1745." Window and door frames are of sandstone of unknown source and seemingly not like any occurring in the vicinity. The right side of the main door is a single sandstone block over 6 feet long, and the door eap is carved.

The Triassic sandstone in the southeast corner of the county is somewhat variable in color. Some beds are definitely a chocolate brown, others mottled red and reddish-gray, still others are brighter red with minute flakes of light mica, and still other portions of this sandstone are composed of quartz grains only slightly tinged with red, but containing a considerable mixture of small brown spots which have an undesirable speckled appearance on the fresh fracture. All of these rocks, however,

are likely to weather or stain so much that the different colors are wholly masked.

In Lebanon and in all of the villages on the Lebanon-Reading highway, limestone buildings are common. Most of them were built many years ago, but some have been erected in very recent years. For instance the combined grade and high school at Annville built in 1928, is a modern use of the local stone. Christ Reformed Church (1903) nearby built of roughly coursed ashlar looks very well, for the limestone has weathered to a light gray; presumably the school will in 15 or 20 years assume the same tone. The Annville National Bank (1895) is of so-called Keystone marble, a very white limestone quarried near Swatara. The blocks over the door and in the cornice are carved and the rest is in rock-faced, coursed ashlar. Some of the blocks show wavy black banding. Most of them appear to be in good condition, and the stone has kept very clean, that in the vestibule being white as if painted. The United Brethren Church (1911) is of a dark gray sandstone of a rather somber appearance.

Several limestone quarries located along the state highway or the Reading Railroad between Palmyra and Myerstown are capable of furnishing rubble on demand, but are operated solely for the production of crushed stone, flux, or high-grade limestone for cement and chemical purposes. The larger of these quarries is that of H. E. Millard on the county line west of Myerstown. It covers several acres and uses three to five steam shovels to load quarry cars. The crushing plant is a large one and the production capacity is a thousand tons or more per day. The Calcite Quarries Company and the Bethlehem Mines Corporation are operating quarries between Myerstown and Lebanon, and there are others in the immediate vicinity of Annville and Palmyra. Considering the durability and pleasing color of the stone and its ready accessibility ever since settlement first began in the valley, it is surprising perhaps that the number of stone buildings is not greater.

In the broad area between the Reading Railroad and Kittatinny Mountain underlain by the Martinsburg shale, stone houses are few because outcrops are not abundant and the sandstone that occurs in these shales is very hard and difficult to work. Quartzite occurs in Bunker Hill just south of Jonestown, and is quarried and ground into sand. I have not observed that this white rock had been used for building stone. Trap occurs also in these hills and in Mount Ararat, and is crushed for road building and other purposes.

The Medina sandstone in Little Mountain, and in Kittatinny Mountain has not been quarried for building purposes because what stone is needed can readily be procured from large blocks or float. This stone is medium, coarse-grained, durable and shows a variety of color including light tan, pink, and gray, but it weathers eventually to a dull tan. It has been used principally in farm buildings along the mountain front where its more or less unattractive color is not a detriment. The stone is durable and easily procured in many places.

LEHIGH COUNTY.

Located in the eastern end of the State, and crossed by a broad limestone valley, Lehigh County, naturally was settled early and now is one of our populous counties, with 502 people per square mile.

Half the population, however, is huddled in Allentown, which numbers over 92,500, and has grown to the east while Bethlehem has expanded westward until now the two cities make a continuous built-up community 8 miles long. Portland cement and roofing slate are the principal mineral resources of the county.

Geologically Lehigh County is like Northampton County which joins it on the east. A considerable area in the South Mountains is underlain by granitic rocks, mostly gneiss. Along the north and south edges of the gneiss, and in some places within the gneiss area is a band of quartzite only a few feet thick. The lowland from Allentown to Coplay to Macungie and Alburty is part of the great limestone valley extending from the Delaware at Easton to the Maryland line at Waynesboro. The northern half of Lehigh County is occupied by the Martinsburg shale formation which includes the slate belt at Slatington. Kittatinny Mountain marking the northwest border of the county is composed of Medina sandstone. A belt of red Triassic sandstone and shale lies along the southeast border.

A description of the building stones in the Allentown area by B. L. Miller is quoted in the chapter on Northampton County.

Gneiss has been used very little in the area, perhaps because some of it is so deeply weathered that fresh stone is well below the surface. Weathered surface blocks have been broken and used in small houses on Fountain Hill at the southwest edge of Bethlehem, and small quarries are known near Center Valley, Spring Valley, and Vera Cruz. The one at Center Valley directly on the railroad was worked recently for crushed stone. It had a face 200 feet long and up to 30 feet high in 1924. These gneisses are mostly coarse-grained, light-colored rocks composed mainly of feldspar and quartz, and with minor quantities of dark minerals, like hornblende, mica, and pyroxene arranged in more or less distinct bands.

Hardyston quartzite ranging from about 20 feet thick near Allentown to 300 feet near Emaus includes beds of fine-grained siliceous sandstone and pebbly conglomerate. It is grayish on fresh fracture but weathers to buff and tan, and may be stained brown or even red on the joint faces. Several quarries have been opened in the south bank of Lehigh River between Allentown and Bethlehem. Here the beds dip north at a high angle and get thicker with depth. These quarries provided stone for some of the buildings at Lehigh University and elsewhere. Those along the river road close to Bethlehem have long been idle. Much of the stone for Alumni Memorial Building (1922) at Lehigh University was quarried on the Cashner property about $1\frac{3}{4}$ miles west of the campus. This quarry is on the north side of the ridge 200 feet above the river and extends 300 feet along the strike. The beds have been uncovered for 75 feet up the dip which is 25° N, with the hill slope. Some joints are normal to the bedding, and some are not, so blocks may have square or beveled ends. The size of blocks taken ranges up to about 1 by 2 by 3 feet. The buildings of this stone at Lehigh are rock-faced random ashlar, rather small blocks predominating. The variegated tints blend well and make attractive masonry. The durability is unquestioned. There are two abandoned quarries in this quartzite east of Emaus.

Limestone, which underlies a large area, has been used mostly for rough construction, like foundations, but some of the farm houses built a century ago are entirely of limestone. For the most part it

weathers to a pleasing gray; the difficulty about its use is that of trimming to shape, for the stone has no regular fracture.

Hard, dark, sandy members of the Martinsburg shale formation have been employed locally, especially for foundations, as has also the waste rock from the slate quarries.

Large blocks of Medina sandstone float on the mountain side above Slatington may have been the source of the stone used in retaining walls and foundations in the vicinity.

Among the notable buildings in Lehigh County constructed of Pennsylvania stone are those in which granite from Seisholtzville was used. The quarries are in Berks County, just over the boundary from Allentown. St. John's Reformed Church (1922) and St. John's Evangelical Lutheran Church at Emaus were built of this granite, with cast stone trim. This stone was used also in Allentown in Emanuel Reformed Church, parsonage of Lutheran Church, residence of John Leh, and in a church in Trexlertown.

The most attractive native stone in the northern end of the county is the Medina sandstone which makes very abundant float on the south

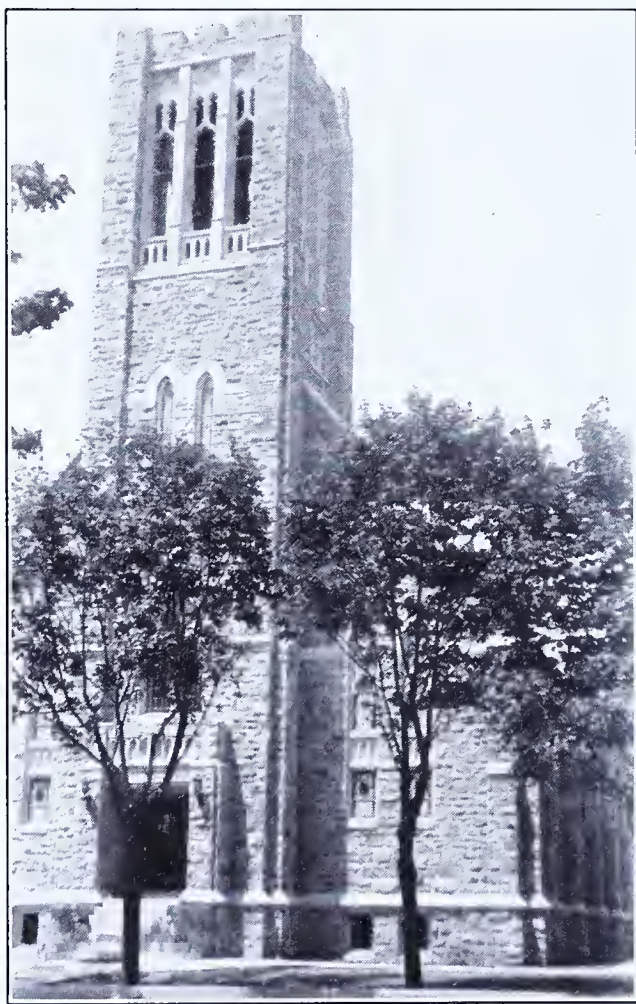


Fig. 108. Jacobs Church, Jacksonville, Lehigh County. Built in 1926 of red Medina sandstone float.

side of Kittatinny Mountain. An interesting example of its use is Jacobs Church (Reformed) at Jacksonville which was built in 1926 with stone taken on the mountain side about 1 mile northwest. The structure is random rock-faced ashlar, and the abundant pink, red, gray, and light tan colors give a warm and cheerful aspect to the beautifully designed church. Although the stone was obtained by breaking boulders on a large rock floe, it is free from any indication of weathering and is so hard that it should prove to be very durable.

LUZERNE COUNTY.

Although its 892 square miles include large, thinly populated areas, nevertheless Luzerne County is exceeded in density of population (499) by only four other counties. Settlement is concentrated along Susquehanna River in the Northern Anthracite Field and in the Eastern Middle Field around Hazleton. The sandstone in the Coal Measures has little or no value for building, but the Pottsville conglomerate which surrounds the coal fields has supplied part of the need for local building stone. The Pocono sandstone which makes the straight ridge from Campbell Ledge near West Pittston parallel with the river and including Shickshinny and Huntingdon mountains, and is repeated in Penobscot Mountain on the south side of the river, has been quarried extensively in more than one place. This massive sandstone also makes Nescopeck Mountain which runs in a straight line for 20 miles across the county, and is the surface rock in Buck and most of Bear Creek townships. Mauch Chunk red beds occupy the valley of Nescopeck Creek and extend along the Lehigh near White Haven. They outcrop also around the Northern Coal Field and where very hard have been quarried for crushed stone. The rest of the county is underlain by sandstone and shale of Devonian age, which include beds that yield flags, curbing, and building stone in some places.

Perhaps because the Pottsville conglomerate is well distributed around the thickly settled portions of the county and has a tendency to make large boulders on the surface very few quarries have been opened for building stone in this county. In several places these large surface blocks have been broken to provide building stone, and in others the excavation for cellars has furnished the necessary material. Large blocks of Pottsville conglomerate are particularly well displayed on the crest of the mountain about one mile north of Hazleton. The presence of the Pocono sandstone, also widely distributed across the county, has made quarrying unnecessary. The rather notable use of the Pottsville conglomerate for curbing in the principal cities in the earlier days has been succeeded by the red quartzite of the Mauch Chunk formation. This comes mostly from quarries near White Haven and even along the Lehigh. At present, so far as I could learn, stone quarries are operating regularly at only two places, White Haven, and on Laurel Run near Wilkes-Barre. The White Haven Quarry Company, Frank Reiser, manager, employs about 20 men at the quarry, 2½ miles north of White Haven and about four-fifths of a mile above the dam at Ice Lake. This quarry has been in operation for many years and is producing, at the present time, curbing and paving blocks, but it can furnish building stone on demand. No mechanical equipment is used other than a derrick by which the large blocks are moved

about the quarry and the finished product is loaded directly on railroad cars. The waste rock from this quarry is crushed in a fairly large plant directly on the railroad. As the Mauch Chunk beds at this locality are hard quartzite the stone is somewhat difficult and expensive to dress into curbing or ashlar, but it is very good for crushed stone to be used for coarse aggregate in concrete or for railroad ballast.

On the east bank of Wright Creek at this same place is a quarry of the General Crushed Stone Company which employs as high as 90 men, making crushed stone largely for highway construction. The product goes mostly to Wilkes-Barre, Scranton, and Hazleton. The beds here are horizontal and the quarry face is about 800 feet long and up to 70 feet high.

On Laurel Run, about 3 miles from Wilkes-Barre, at the mouth of Kelly Run, is the other active quarry in this county. Here the Mauch Chunk red sandstone is very dense and hard. The beds stand at a high angle, dipping northwest into the ridge, and as the bedding is massive the rock is suitable for curbing, steps, sills, etc. The present output of the quarry, however, is crushed stone. It is owned by Wm. B. Delaney, Jr., who, in 1929, was developing the quarry so that eventually he would have a face about 100 feet high and a capacity to meet any demands from the near by cities.

Campbell Ledge, a conspicuous cliff on the Susquehanna above West Pittston and back of the Lehigh Valley railroad roundhouse, has furnished more or less building stone, and much crushed stone for the neighboring cities. A quarry at the base of this ledge formerly worked by Mr. Hunger, has been idle for 10 years. It has a face at least 100 feet high on steeply pitching beds. The bedding is both thin and massive, but the massive beds are very hard and of a gray to greenish color which weathers to a greenish brown. A large crushing and screening plant indicates that the principal product was crushed stone, but light yellowish sandstone in buildings in Wilkes-Barre are said to have come from this quarry. Building stone could still be produced from this quarry but it would be somewhat difficult on account of the steep dip of the beds.

Hazleton. The number of stone buildings in Hazleton is notable. According to custom in this part of the country a number of the banks are built of Indiana limestone on a polished granite base. The choice of stones for churches, however, is more variable. Examples of the use of Pennsylvania building stones follow.

St. Gabriel's Roman Catholic Church (1925) on Wyoming and West Elm Streets, is one of the finest stone churches in the city. It is built of pink granite from Seisholtzville in rock-face, random ashlar and laid with white mortar. The trim is Indiana limestone. The front steps and the water table at the sides and rear are sawed and dressed Seisholtzville granite. As this building is only a few years old the pink and red colors so characteristically mottled in this granite are conspicuous.

On the other side of the city St. Mary's Roman Catholic Church (1927-29) at West 12th and North Vine Streets has a base of Seisholtzville granite, water table and trim of Indiana limestone, including fine carving over the doors, and the main walls are of Mt. Airy, N. C. granite in rock-face, random ashlar. According to the priest

the North Carolina stone cost less per ton delivered than did the Seisholtzville granite.

The use of the local Pottsville conglomerate is illustrated by St. Joseph's Slovak Roman Catholic Church (1905) at North Laurel and West 6th Streets. The rock-faced, random ashlar has a pleasing tone, that might be described as either slightly reddish or tan. The adjoining parochial residence (1928) of the same stone from the mountain near Silver Brook was built in the same manner, with Indiana



Fig. 109. St. Gabriel R. C. Church, Hazleton. Built of granite from Seisholtzville, Berks County.

limestone trim, and has a reddish tinge that is very pleasing. It is possible that the parochial residence in the course of 20 years will acquire the same indefinite tone as the masonry of the church.

Christ Lutheran Church at Church and Green Streets and the parish house are of black banded mica schist from the Rock Hill quarries at Cynwyd, Montgomery County. The church was being erected in 1929, with cast stone trim. Rock faces with occasional brown seam faces give a rather somber effect which is lightened here and there by the scintillation of micaceous faces. The stones framing the windows are tool dressed for contrast.

Trinity Evangelical Lutheran Church (1887-1904) on North Church Street has a very dignified appearance due to the rock-face, random ashlar in gneiss from Port Deposit, Maryland. This stone shows very little stain in spite of the length of time it has been exposed.

Beth Israel Church on North Church and West Hemlock Streets is red brick with a foundation, retaining wall, and steps of red quartzitic sandstone from the vicinity of White Haven. This Mauch Chunk red sandstone is readily identified by the narrow, parallel banding due to slight difference in color of the bedding planes.

Markle Memorial Library is of white marble from Vermont. This marble is slightly streaked and shows some chipping; in other words it has not proved wholly durable.

The Peoples Savings and Trust Company bank also is white Vermont marble with drab streaks, but apparently in good condition. The United States Post Office at Hazleton is Indiana limestone.

Between Hazleton and Wilkes-Barre one may note that at the gap on Nescopeek Mountain cobbles and bowlders have been used for building stone, and on the north side of the mountain stone fences of red, flaggy sandstone and rounded bowlders are common. These bowlders are of glacial origin. The only stone building in Mountaintop is of glacial bowlders. The retaining walls on the highway between Mountaintop and Ashley are massive blocks of Pottsville conglomerate.

Wilkes-Barre. Here too the banks and large office buildings have polished granite bases and Indiana limestone walls, so the churches and schoolhouses are of more interest to one studying Pennsylvania building stones. The First Presbyterian Church at South Franklin and West Northampton Streets is a large and attractive building, but one's attention is drawn to the fact that the main building (1886) is of White Haven red sandstone showing distinct bedding in bands about $\frac{1}{4}$ inch thick while the parish house, a recent addition, is tool-dressed Hummelstown brownstone, which lacks any distinct banding. Much carving over the main doors shows what can be done with the White Haven stone.

St. Stephen's Episcopal Church (1897) also on South Franklin Street is a light tan sandstone now soiled and weathered to an unattractive color. The new parish house addition is of the same or similar stone, but having been exposed to the weather only a few years still shows bright variegated tans and presents a very pleasing appearance. This stone is from the quarry at West Mountain, Hyde Park, Scranton.

The City Hall (1893) at Washington and Market Streets is of Hummelstown brownstone with massive rock-faced base courses 2 feet thick. A casual inspection indicates that this stone is in good condition. The high school on North Washington Street above Market is Indiana limestone with White Haven red sandstone foundation. This school was built in 1909.

Conyngham Post Memorial Hall is of brownstone that resembles the Hummelstown product.

St. Nicholas Roman Catholic Church (1883) on South Washington Street is built of White Haven red sandstone in rock-faced ashlar which has darkened by soiling and the lighter dressed faces have a

faded appearance. The parochial school (1913) beside the church is of the same White Haven red sandstone except the main doorway and the window caps which look like Hummelstown brownstone.

The First Methodist Church (about 1885) on Franklin Street north of Market is a yellow, soft sandstone said to be from West Mountain at Scranton. The base is White Haven red sandstone.

The Presbyterian Memorial Church (1872) on North Street two blocks from the courthouse is of light, yellowish buff sandstone from Campbell Ledge, laid as massive rock-face rubble except the buttresses which are rock-face ashlar and the steeple which is smooth ashlar. All of the masonry except under the eaves is now badly stained black and looks as if it had been through a fire. The stone itself appears to be in good condition, but the color and the quartz pebbles, which show distinctly as white spots in the blackened sandstone, make the whole effect very gloomy and far from attractive. There is a carved inscription in the stone quoins over the front door and around the big circular window. The doorstep is a single stone 10 feet by 30 inches by 6 inches, and the flight of steps is built of blocks 10 to 12 feet long. The retaining wall along the sidewalk is of the same stone.

St. John's Evangelical Lutheran Church (1915) at Academy and South River Streets is entirely of Hummelstown brownstone and looks very well. The pastor said that White Haven stone was not used because it is so expensive to dress.

The granite in the new Market Street bridge over the Susquehanna at Wilkes-Barre is said to be from Woodbury, Vermont.

Red flag walks are common in Wilkes-Barre and the use of coping on yard fences is notable. Some of these coping stones are particularly large, as for instance, at the corner of South Street West and Barnum Place where White Haven red sandstone coping about 15 inches square and 30 feet long were used. Much of this White Haven sandstone has been used also for foundations and for doorsteps in the better residences.

On Wyoming Mountain east of Wilkes-Barre quarries have been opened in several places along Sullivan Trail but none are operating at present. Here the nearly flat-lying Pocono sandstone has a pleasing color on fresh fracture, but the stone weathers to an unattractive greenish buff. These quarries may have been opened for road metal but they could furnish building stone as well. At Bear Creek a number of summer homes have been built around the reservoir. All stone retaining walls and foundations are of float which is so abundant that it has not been necessary to open a quarry.

The Luzerne County courthouse (1915) is Ohio sandstone in massive coursed ashlar. The lower part is rough tooled, and the upper stories smooth faced.

Kingston. In this vicinity no notable stone work attracted my attention. Red sandstone probably from Laurel Run and yellow sandstone from Campbell Ledge have been used in some foundations. The Methodist Episcopal Church (1917) at Forty Fort is all Hummelstown brownstone in random ashlar and looks very nice and clean, probably because it has been exposed to the atmosphere only a few years.

In the ravine along a concrete road northwest of Wyoming there is

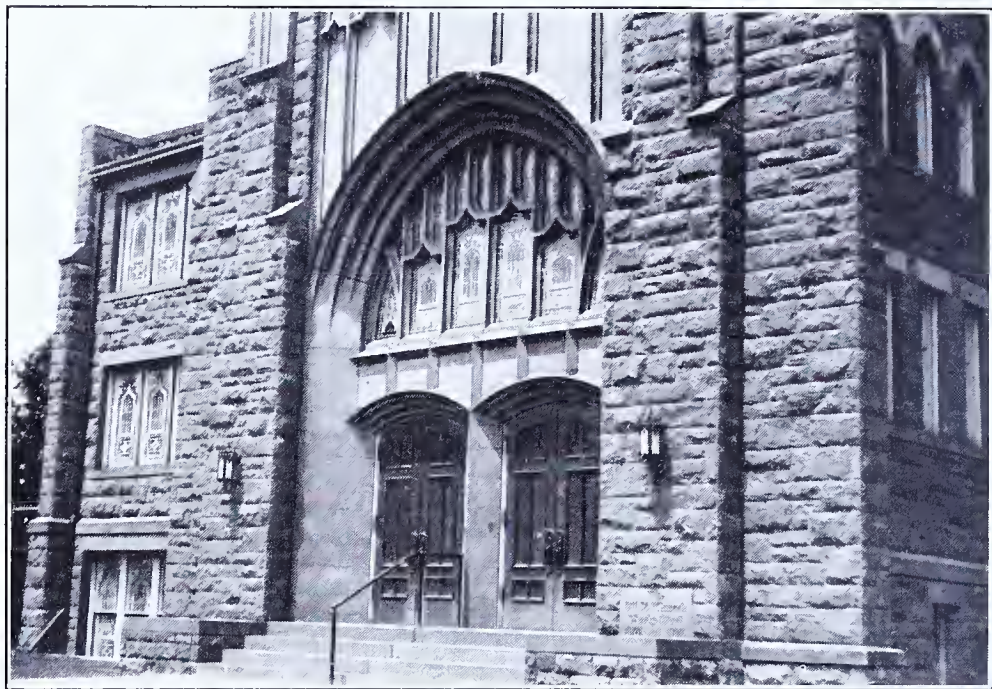


Fig. 110. Hummelstown brownstone in Methodist Episcopal Church, Forty Fort, Luzerne County.

a large quarry in bluestone that was operated for a number of years for crushed stone. The property is now owned by the Dime Savings Bank of Pittston. The rather massive beds dipping southeast could produce dimension stone. Some of the rock has highly micaceous faces. On the W. P. Sax farm is a quarry that was worked by George Hess in 1927 for road metal. This quarry has a 40-foot face about 60 feet long, and was worked with air drills. All of the machinery has been removed and the stone is too thin bedded for good building material; furthermore, the bedding is decidedly irregular. It is a hard, almost quartzitic gray sandstone of the Catskill formation.

From Truxville to Dallas along Toby Creek are many stone fences of slabby, red, gray, and green Catskill sandstone. This stone has been used also in revetments along the creek and in retaining walls for lawns. In these towns also are new yard walls of Pottsville (?) conglomerate and of glacial cobbles. The shore of Harvey Lake in places where cottages are very numerous have been revetted with the same red and green sandstone. Although the west shore is completely lined with cottages from Shawanese to Alderson, I saw only one stone house, and that, at Laketon, is of red sandstone rubble and cobbles.

Pittston. Several buildings have bases or front approaches and steps of coursed Nicholson (?) bluestone. The base and door trim of the Y. M. C. A. building (1904) are Triassic brownstone from Hummelstown. Several banks are faced with Indiana limestone. Red-banded quartzose sandstone from the Mauch Chunk formation, and looking like the White Haven or Rockport stone, has been used as ashlar in house foundations and porches, as in the parochial residence across the street from the Catholic Church.

St. John's Catholic Church (1889) is tan to reddish sandstone in rock-face, random ashlar, from a quarry at White Haven. The trim is Indiana limestone.

LYCOMING COUNTY.

Lycoming, the largest county in the State, with an area of 1,220 square miles, is north of the center and crossed by the West Branch of the Susquehanna. Williamsport is the county seat. Much more than half of the population is concentrated in towns and cities on the bank of the river, and 45,729 of the 93,421 are in Williamsport and South Williamsport. All of the northern half of the county is very thinly settled.

In the southern half are Bald Eagle and White Deer Mountains, narrow ridges rising abruptly 1,000 to 1,300 above the river, made by the resistance to weathering of the Juniata and Oswego sandstones. These ridges enclose Nippenose Valley which is underlain by Martinsburg shale and Trenton limestone. North and east of the river is a belt several miles wide which rises generally less than 500 feet above the river and is underlain by the Helderberg limestone, shales and flags of the Middle Devonian and by red Catskill sandstone.

North of this belt the country rises abruptly along the Allegheny Front to a deeply dissected plateau ranging in elevation from 1,700 to 2,200 feet. Much of this high country is Pocono sandstone, with large and small areas of Pottsville conglomerate and Coal Measures along the north and west sides of the county. The larger valleys in this high country are cut down into the Catskill beds.

From the above statement it will be recognized that the sources of building stone are the Trenton and Helderberg limestones, the Medina, Catskill, Pocono, and Pottsville sandstones, and any suitable beds in the Hamilton and Portage rocks.

In the rural districts the use of stone for whole buildings is very rare, and for the necessary foundations the nearest abundant float is used, whether it be limestone or sandstone. In the city and larger towns, however, where large groups of people unite in some common object, the larger resources result in the erection of enduring edifices in stone. The greatest number of stone buildings therefore is in Williamsport, which happens to have building stone quarries on its northern border and a great abundance of float stone on the mountain across the river.

The only building stone quarry observed in operation in Lycoming County in 1929 was that of George Myers in Hammonds Run on North Market Street at Williamsport. This quarry was opened originally in the Hamilton shale to get shale for making brick and was worked many years for this purpose. It has a face 300 feet long and 80 feet high on shale and sandstone beds dipping N.10°. Large quantities of rubble have been produced here for cellar and retaining walls, and in 1929 Mr. Myers was employing 6 or 8 men getting out building stone and rubble. Joints cut the strata at right angles and much of the stone breaks out naturally in rectangular blocks. It is raised entirely with bars and wedges. Joint faces are rusty and fresh fracture faces are steel gray, which is said to get lighter on exposure. Several houses and an outside staircase above a reservoir in Grampian Hills, a new subdivision of Williamsport, are built of stone

from this quarry. The general effect is rather dark, but it can be lightened with a generous use of white mortar for pointing.

Two other quarries farther up the run and in slightly higher beds have not been worked for some years.

On top of the mountain along the road between South Williamsport and Montgomery float blocks of red and white Medina sandstone are very abundant and have been taken at many places on the north slope, probably to be used largely for rubble foundations.

Flagstone is quarried at several places on Pine Creek, including Waterville, Jersey Mills, Blue Stone, and Slate Run. Shipment is by railroad to Buffalo, Philadelphia, and points between. At Slate Run much of the stone is gray, brown, or purple rather than blue.



Fig. 111. Flagstone yard at Slate Run, Lycoming County.



Fig. 112. Coleman bluestone quarry, Slate Run, Lycoming County.

In 1930 several quarries were being operated, producing flagging and curbing. A considerable stock of brown and purple flags up to 6 feet square was in the railroad yard at Slate Run and a smaller quantity at Jersey Mills.

The old Coleman quarry about 1 mile above Slate Run village on the crest of the ridge was a big producer but has not been worked in 30 years because the face has advanced to where the over-burden is too heavy.



Fig. 113. Limestone quarry at Hughesville, Lycoming County.

Limestone is quarried for crushed stone and for making lime at several places, and can be procured for rough building stone. Close jointing, as seen in the quarry at Hughesville, would interfere with the production of dimension stone.

Stone Buildings.

Jersey Shore. The principal stone building is the Presbyterian Church (1894) which is built of a coarse-grained, gray to pink sandstone brought from Bald Eagle Mountain. Probably it is of Medina age and was taken from float stone, which is abundant on this ridge. The main door stones, the door arch, and window sills are fine-grained greenish sandstone, probably bluestone from the Catskill beds on Pine Creek.

Some of the curbing and flagstones in Jersey Shore were quarried near Jersey Mills on Pine Creek, and red banded, hard, fine-grained sandstone used in retaining walls and porch pillars is from the north side of Bald Eagle Mountain near Antes Fort and may be of Clinton age.

Williamsport. White marble from Chester County was used for the main walls of several prominent buildings in Williamsport. Some of it was reported to have come from Avondale and some from the Penn-

sylvania Marble & Granite Co., so I assume that its source was the quarry of that company at Bakers Station between Avondale and West Grove. The buildings of this stone are Pine Street M. E. Church (1907), St. Paul's Lutheran Church (formerly Central Presbyterian), Central Presbyterian Church (1910) opposite Park Hotel, and the James V. Brown Library (1906). The library steps are Barre (Vt.) granite. This marble has weathered gray but it appears to be durable; at least it has not had to be patched like some of the Pennsylvania marble buildings in Philadelphia.



Fig. 114. The James V. Brown Library, Williamsport. Built of white marble from near Avondale, Chester County.

The Evangelical Church on Market Street and Calvary M. E. Church (1923) are Mount Airy (N. C.) granite; the Masonic Temple (1897), Susquehanna Trust Company (1922), and new part of the Lycoming Trust Company buildings are Indiana limestone; the Scottish Rite building (1902) is Hummelstown brownstone, and the Salvation Army Citadel has sills and keystone of Warsaw (N. Y.) sandstone.

The U. S. Post Office (about 1890) is large blocks of blue marble, the source of which was not learned.

Trinity Church Episcopal and the front of the First Baptist Church are "mountain stone," brought from Hageman Run, which makes a gap in Bald Eagle Mountain directly south of Market Street. The stone in these churches is now much discolored, but it is assumed that they are Medina and possibly Clinton sandstone. Whether it was quarried from bedrock or broken from float was not learned.

One informant said that the float stone is flinty and hard to dress and that the making of cut stone, steps, sills, etc., was abandoned because the stone eventually goes to pieces. I suspect this may refer to stone from the Clinton beds.

The County Jail (1867-8) is of local green, gray, and red sandstone, some of which is scaling. The trim is brownstone.

Montgomery. As the main street in Montgomery is on a hillside, the

yards on the upper side have masonry retaining walls and buildings on the lower side have high foundations, all apparently of Medina rubble from Bald Eagle Mountain.

Muncy. Although located on Clinton shale and Helderberg limestone the building stone used in Muncy is largely the Medina sandstone from the slope of Bald Eagle Mountain on the other side of the Susquehanna. Thousands and thousands of tons of floor rock lie on the mountain face, with no ledges exposed above. The stone on fresh fracture is light tan, buff, pink, or reddish; some blocks are all one color, some have parallel straight or curved striping in narrow red bands. It dresses well and makes good-looking walls. The Lutheran Church (1905) and several houses in Muncy are of this stone, as are also the buildings of the Pennsylvania Industrial Home for Women on the west side of the river.



Fig. 115. Medina sandstone, Industrial Home for Women, near Muncy, Lycoming County.

A house on Front Street at the end of the river bridge is built of local limestone and is over 100 years old. The limestone appears to be durable.

Hughesville. In the midst of Devonian beds, it is notable that the foundations of some houses in Hughesville are red sandstone. This stone has been used also for porch pillars. Just where it came from and whether it is Chemung or Catskill sandstone was not determined. One house here and a bungalow in Picture Rocks are built of cobbles. A rock-face, random ashlar retaining wall in Picture Rocks also is local red sandstone.

Pine Creek. Building stone has been shipped from Waterville to

Williamsport, making use of the heavier-bedded bluestone. Flagstone is produced at several stations on the railroad along this creek, and its use for flagstone is common in these small settlements. Flagstones notable for size are in front of E. Horn's store at Jersey Mills.

McKEAN COUNTY.

McKean County, with an area of 1,000 square miles and a population of 55,000, is one of the northern tier. It was named for Thomas McKean, an early governor, and one of the signers of the Declaration of Independence. It is distinguished as the site of the Bradford oil pool and the Kinzua viaduct. This county is a high plateau, many of the uplands being above 2,000 feet in elevation. The plateau is deeply dissected by narrow valleys up to 800 feet deep. These valleys are mostly in Devonian shales. The uplands are underlain by massive sandstones, and in the southern part of the county the valleys are also, for the streams have not cut below them.

The sandstones suitable for building material are in the Pottsville series. Locally they are known as the Johnson Run and Kinzua Creek sandstones and Olean conglomerate. These are equivalent to the Homewood and Connoqueuessing sandstones and basal Pottsville conglomerate. So far as the writer could learn sandstone is not quarried from the parent ledge at present and little if any such quarrying has been done. This is because the massive sandstones underlying the plateau have weathered out in large blocks which strew the upland surface and the higher hill slopes. These blocks lying on the surface range up to 10 by 20 feet in cross section and by breaking them a supply adequate to all past and present demands has been obtained. The uppermost sandstone, found commonly on the flat uplands, is an even-grained stone, varying in color from gray to pink and buff, owing to the presence of iron. These colors may be evenly distributed, or they may be streaked. To some people these iron stains and varying colors add to the attraction of the stone. Long exposure may increase the colors but accumulations of black soot or other stain are likely to mask any other changes due to weathering. This sandstone is easily broken to rectangular blocks of desired dimension and dressed well to rock and smooth face.

The Kinzua Creek sandstone lies below the Alton coal and, like the Johnson Run sandstone, is 30 or more feet thick. As the rocks lie nearly horizontal in McKean County, this sandstone outcrops on the uplands surrounding and at a slightly lower level than the Johnson Run sandstone. They are similar in texture, color, and workability. Rimming the plateaus and outcropping mostly below the general upland level are the conglomerate ledges at the base of the Pottsville, and the older Pocono sandstones. These contain some sandstone like the higher beds, but also contain more friable beds and some with an abundance of quartz pebbles the size of a pea. The massive and coarse-grained beds are suitable for rough masonry and some of them might do for construction requiring strength and durability. They would not be so satisfactory however, as the even-texture sandstones taken from higher beds.

In Bradford the use of dressed sandstone in retaining walls for lawns along hillside streets is notable. Blocks 6 to 8 inches thick have

been used extensively. The City Hall is a brick building with first floor of massive sandstone masonry. Sills 7 feet by 15 inches and blocks of smaller size are coarse-grained sandstone probably of local origin. Smoke staining so common in town masks the color. The sandstone foundation of the Hill Memorial United Brethren Church contains small fossil shells and was surmised to be from Warsaw, New York. An old resident told me that most of the heavy masonry came from up the West Branch of Tunungwant Creek and from the vicinity of Big Shanty Hill, which is about 8 miles south of Bradford on East Branch, and that all had been broken from loose blocks.

A notable example of the use of this native stone is the First Methodist Episcopal Church at Bradford, built in 1924 of sandstone

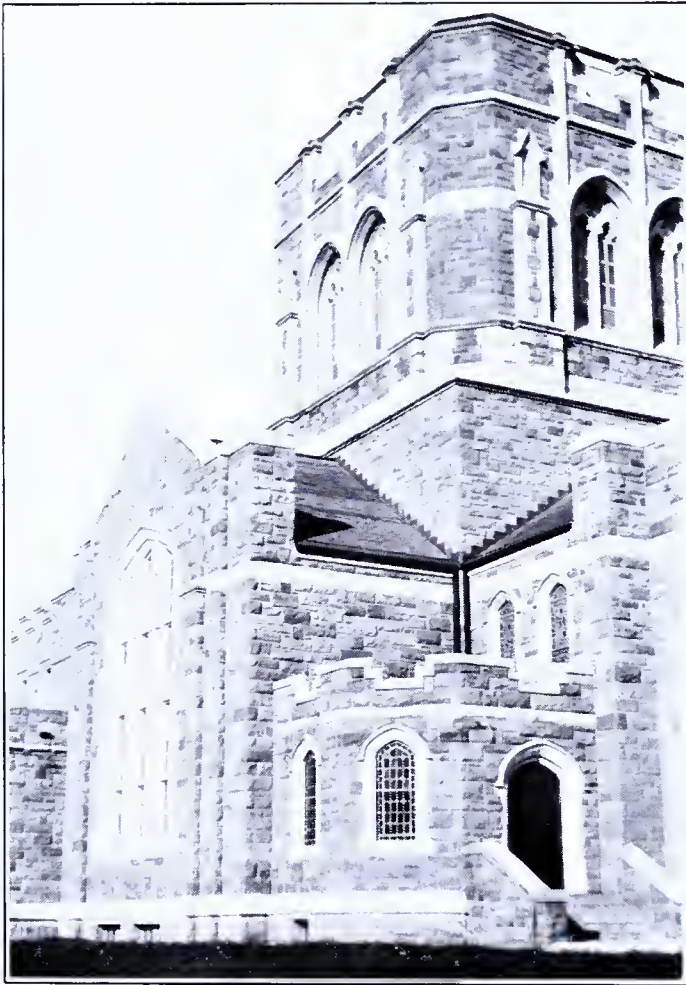


Fig. 116. First Methodist Episcopal Church (1924), Bradford, McKean County, built of local sandstone.

obtained on Lewis Run 6 miles south of the city. The stone is an even-grained siliceous sandstone, its color including gray, pink, light red, and some stained brown in streaks. In 1928 the outer walls were beginning to show smoke stain but under the portico the original pink color is preserved. Blocks in the building are up to 10 inches thick

but few are over 2 feet long. They are laid in random ashlar with rock face, to which this stone dresses well.

I did not try to determine from which geologic horizon this stone came because it seemed not to matter, the product of the different beds being very similar.

A gray coarse-grained sandstone outcrops at the north end of Kinzua bridge and along Kinzua Creek just below the plateau. Large blocks occurring in the street at Kushequa may be Pocono sandstone.

Mount Jewett and Kane on the Roosevelt highway have few stone buildings, though foundations of local sandstone are common. According to Ashburner¹ the Thomas Memorial Church at Kane was built of a local sandstone colored a beautiful pink and yellow by iron, but the walls now are gray. Attractive pink and cream colored sandstone in well-dressed blocks was being used for house foundations in Kane in 1928. This was taken from loose surface stone. Near Ludlow blocks of gray conglomerate, some as large as a shanty, are conspicuous along the road. The only use noted of the abundant material is in foundations and retaining walls.

The browstone in Methodist Episcopal Church at Kane came from Hummelstown.

Flagstone was formerly quarried near Norwich, according to Ashburner (Report R, p. 121). A quarry was opened in 1877 in the Red Catskill beds outcropping northwest of Norwich, on Orlando Gallup's land. The flags were hauled to Hamlin Station and shipped mostly to Buffalo for pavements. Flags 1½ inches thick measured 4, 5, and 6 feet by 2 or 3 feet; flags 2 inches thick were 5 and 6 feet long by 4 to 6 feet wide. Flags as large as 10 by 10 feet were raised. As these strata occur on both sides of the main valley near Norwich, should occasion demand, the flagstone industry could be revived here by opening other quarries. Flagstone was quarried also high on the hill south of Port Allegany but for many years this old industry has been discontinued. Red Catskill sandstone used to be quarried north of the town. Massive sandstone and grit are abundant in large blocks in the hollows, and are derived from the Pocono sandstone that outcrops high in the hills around Port Allegany. Rough building stone therefore is abundant here.

To sum up, the sandstones that have been used in McKean County for years are durable and abundant. The attractive colors of some of the freshly broken stone fade to gray or are masked by other stain in the course of years.

MIFFLIN COUNTY.

This county in the central part of the State, between Centre and Juniata counties, lies along Juniata River in the Vallemont region of the State. Folding of the earth's crust has exposed the geologic formations in long narrow bands running lengthwise of the county, the hard rocks making the straight mountain ridges, and the softer rocks the valleys. The Tuscarora and Oswego sandstones that form the Blue Ridge between Juniata and Mifflin counties are repeated in Jacks Mountain, and in the Seven Mountains beyond Milroy. The

¹ Ashburner, C. A., *The geology of McKean County: Pennsylvania Second Geological Survey, Report R, p. 85, 1880.*

structural folds are so close at Lewistown, the county-seat, that in a distance of 2 miles the Helderberg limestone is repeated six times; that is, in crossing the ridges between the Juniata at Lewistown and the red shale valley near Yeagerstown one would find nearly vertical beds of Helderberg limestone in six separate bands.

The geologic section exposed in Mifflin County extends from the Trenton limestone to the Devonian shales above the Oriskany sandstone. In this section are the two limestones, Trenton and Helderberg, which can be used for rubble masonry and for rough ashlar; the pebbly sandstone of Oswego and Tuscarora age, which constitute the "mountain stone" throughout this region and have been used locally for both rough and dressed building stone, and the hard sandstones in the Martinsburg, Catskill, and higher shale formations.

As Mifflin is very definitely a rural county, the principal use of stone in buildings has been for barn and house foundations, with here and there a whole house of stone. Bridge abutments and piers built before the present century are mostly of local dressed stone, although some of the very massive blocks in railroad bridges came from elsewhere in the State.

Building stone suitable for common needs is so abundant throughout the county that one may assume a near by source for the stone in the older buildings, mountain sandstone being used for all stone buildings in or close to the ridges, and limestone in the broad valley from Allensville to Milroy. Lumber was so readily available in the old days, all of the numerous ridges being in forest, that stone buildings are rare.

Stone Buildings.

Lewistown. The county-seat has several churches and a club building in which native stone is the principal building material. The



Fig. 117. Medina sandstone, St. Mark's Church, Lewistown, Mifflin County.

oldest one observed by the writer is St. Marks Protestant Episcopal Church which was erected in 1824. It was rebuilt in 1902 and in 1926 a Sunday School room, parsonage, and yard wall were added. Stone in the new part is quartzite from the rock floes in Lewistown Narrows formed by breaking up of the Tuscarora and Oswego formations. The rock is various colors, including white, black, gray, red, and greenish, but the juxtaposition of dark and light blocks gives a patchy effect to the wall. In a few years, however, it will become soiled like the older part of the building and contrast will then be reduced. The stone unquestionably is very durable, and the colors fade so slowly that the writer feels sure if the oldest walls in the church were cleaned by sand blast they would show the same colors as the newest walls.

The Methodist Episcopal Church (1899) at the corner of Third and Dorcas Streets, is built of Helderberg limestone from a local quarry. The stone is in rock-faced random ashlar up to 12 inches thick, and all apparently sound. Some blocks are dense, very fine-grained, nearly white; some are gray and crystalline; and others are a mass of shell fragments. Even in the same block, part may be nearly white, and part dark gray. The general effect is fair.

The Roman Catholic Church (1921) on the opposite corner is believed to be Oriskany sandstone from the formation which outcrops in the town. The blocks, which range from 4 to 12 inches thick, are mostly gray, with rare red or brown iron stain. The trim is cast stone.

Trinity Reformed Church is in two strongly contrasted parts. That which was erected in 1903 is stained dark but the new part, built in 1926, is very light. The whole building is vari-colored quartzite of local origin and supposed to be Tuscarora quartzite derived from the extensive rock floes in Lewistown Narrows. In the newer part the rock-face random ashlar is gray, very light tan, rarely reddish, and fossils are rare. The trim is cast stone.

A very good looking new stone building is the Elks Club house one block west of the town square. This was built in 1928 of sandstone float from the south slope of Slim Valley Ridge near McAlisterville, 12 miles east of Lewistown. Although the Second Survey map of Juniata County shows this area underlain by the Clinton formation the writer suspects this ridge is made by a minor fold that has brought the Tuscarora sandstone to the surface. The rock is variegated, including almost pure white, white slightly banded, light tan, light red, red and tan banded. Many surfaces are covered with 1/8-inch, brown sections of crinoid stems in a light matrix, and some show spirifers and other shells. The stone doubtless is durable and the effect of the light, variegated wall is pleasing. The trim is cast stone. Some residences in the newer parts of Lewistown are built of this stone from McAlisterville.

Grace Evangelical Church (1925) is a fine new edifice of light gray granite from Mount Airy, North Carolina.

Float from the Oriskany sandstone is abundant on the mountain southwest of Lewistown along the road to McVeytown but much of it is soft and might be difficult to dress.

McVeytown. The long stone wall in front of the Mattawana cemetery built about 1924 is white and tan quartzite or ganister from Oriskany sandstone float on the hill 1/4 mile west of the village square. The stone in an old store building on the corner of the square probably

came from the same source but the coats of paint hinder its identification. The piers of the highway bridges over Juniata River at McVeytown, and the Pennsylvania Railroad station at Mattawana are the same rusty to white fossiliferous Oriskany sandstone but from another source, a low ridge near the Amish Church at Mattawana, where this stone is brought up by a minor fold.

The large slab of sandstone bearing an historical tablet in the square at McVeytown is Tuscarora or Oswego sandstone from the floe on the Lakes to Sea Highway west of Milroy in the first gap of Seven Mountains.

At Ryde on the Pennsylvania Railroad is a 10-arch skew bridge over Juniata River built of large blocks of gray to light buff, sugary sandstone and fine pebble conglomerate. The source of this stone was not learned.

MERCER COUNTY.

This county is on the west border of the State between Crawford and Lawrence counties. Its rocks include from the middle of the Lower Productive Coal Measures to the shales below the Shenango sandstone. I did not find that building or flagstone is produced in Mercer County at present. At only one working quarry could fairly good gray sandstone be produced readily.

The White Rock Silica Co. operates a quarry $1\frac{1}{2}$ miles south of Greenville opposite the country club on the Mercer road. The Bessemer Railroad passes within a few rods of the quarry. The rock is a blue to gray, feldspathic sandstone, cross-bedded, saccharoidal, and in part gritty or containing small quartz pebbles. It is believed to be the Sharon conglomerate. The quarry is on top of a hill in flat-lying beds and covers an area about 100 by 400 feet. A cover of 5 feet of glacial material was removed and the quarry sunk 20 to 30 feet. The rock is crushed and sold for road metal and chemical purposes; some also is pulverized for steel molding, building, and traction sand. Building stone is not produced but it is believed that the lower beds in the quarry might be employed for this purpose. The upper beds are too thin and soft.

Other quarries now operating are those of the Leesburg Silica Co. $\frac{3}{4}$ mile north of Leesburg, the Mercer Sand Co. and the Youngstown Sand Co. on Neshannock Creek $1\frac{1}{2}$ miles north of Leesburg. The sandstone at these quarries is soft, sugary, gray, tan, or brown, and is crushed for furnace lining and steel molding sand. The stone is not particularly suited for building purposes.

The whole county is covered with glacial drift, which masks bed rock, and in some valleys is 60 to 80 feet deep. This drift includes boulders of granite, gneiss, and greenstone as well as local rocks, and these have been used in some places for building stone, either in their rounded form or broken and dressed to flat faces.

In view of the fact that building stone has not been quarried much in this country for many years the principal source of information on this subject is White's report,¹ from which the following statements are gleaned.

None of the sandstones in the Coal Measures is a desirable building stone. The Vanport limestone is restricted to a few small areas along

¹ White, I. C., *Geology of Mercer County, Pennsylvania* Second Geol. Survey, QQQ, 1880.

the County line east of Leesburg and to some hilltops in Jackson Township. It is reported to be 12 to 15 feet thick along Wolf Creek, where it makes long lines of cliffs in Liberty Township; and 9 to 12 feet thick at the quarries in Jackson Township. The upper part of the limestone is light gray and the lower part is dark blue. Probably it does not break right to make good building stone.

The Homewood sandstone in this county is 30 to 70 feet thick, massive, coarse, grayish-white rock, in some places conglomeratic. In the streets of Mercer 110 feet above the railroad this sandstone has been exposed. It rises from the bed of Wolf Creek at Courtneys Mills, 3 miles south of Grove City, and makes a 30-foot cliff around the head of a ravine south of Sandy Lake. Where it is massive and free from pebbles it is good building stone.

The Connoquenessing upper sandstone is lacking in many parts of the county but between Mercer and the Lawrence County line it is well developed. White says: "At B. F. Drake's quarries a cliff, 40 feet high, surrounds the head of a ravine. The stone was used for the new court house in Mercer. It is light grayish, tolerably coarse, and pebbly near the top of the quarry. The natural face of the cliff is weathered into fantastic shapes." From the context I assume that this quarry was near Leesburg. This same sandstone outcrops in Mercer below the Homewood sandstone. It forms cliffs along Neshannock Creek below Mercer, and on the north and south sides of Sandy Lake.

As it was used for the court house in Mercer one may assume that in some places this sandstone can produce a fair grade of building stone.

The Connoquenessing lower sandstone, occurring 35 to 50 feet below the upper, is like it in variability, being present in some places, massive and thick, and in other places absent. It is 40 to 90 feet of grayish-white sandstone and has been used locally for building stone. Fifty years ago building stone was quarried from it at McClary's one mile east of Sharon, but some of the layers were hard and dressed with difficulty, and some of the stone was much cross-bedded. White says this sandstone causes a cascade 40 feet high at Campbell's Mills, on Campbell's Run in Springfield Township. I fancy this outcrop is half a mile up the stream called Mill Run on modern maps.

On the north shore of Sandy Lake it is 50 feet thick and massive where exposed by a run, and east of the lake blocks as big as a house have broken from the ledge.

The Sharon conglomerate, lying below the Sharon coal, is a massive sandstone in the central and northern part of the county, and is very conglomeratic in townships along the western border. At Sharon, the type locality, it is 20 feet thick; the upper half is a moderately coarse, white sandstone, and the lower half is a mass of rounded pebbles smaller than a hickory nut, loosely cemented in bluish gray sand. The sandstone free from pebbles is an excellent building stone and was used for the locks on the Beaver and Erie Canal built in 1844. The stone is very durable, as evidenced by the freshness of chisel marks 50 years old. Stone for the locks was extensively quarried about 2 miles above Bigbend or $1\frac{1}{2}$ miles below New Hamburg where the Sharon is a coarse-grained, grayish-white sandstone. The lower part is flaggy in this locality and has furnished excellent flagstone. In fact, at Greenville this horizon is a flagstone formation and 50 years ago

the Greenville flags were well known in western Pennsylvania. The several quarries on the west bank of the Shenango at Greenville yielded flags 2 to 8 inches thick of almost any desired size and with very smooth surfaces.

Fifty years ago in the 1870s a quarry in the Sharon conglomerate just west from Fairview village furnished coarse, massive, reddish-white sandstone that dressed nicely into handsome building stone. The ledge forms a line of cliffs around the hill and doubtless similar stone could be taken here again.

The Shenango sandstone, about 40 feet lower in the section, is persistently found at the proper horizon, though it is only 10 to 20 feet thick. It is generally a coarse, brownish-white rock, often quite soft, usually containing shale pebbles, and always large numbers of iron ore balls. Also it is very rich in fish remains. It was quarried many years ago for building stone at Whittakers Falls west of Sharon, in the northeast corner of Delaware Township, and in many places along the Shenango. A large quarry on the right bank just above Bigbend and 150 feet above the river, where this ledge is 25 feet thick, furnished much stone for canal locks. The stone splits and works easily, has a grayish-white color, specked with iron oxide, when fresh, and weathers to a light tan. The presence of shale pebbles and iron ore balls renders much of this stone undesirable for dimension stone.

A still lower sandstone exposed in a railroad cut just above the dam at Greenville, and rising above waterlevel at Sharon so that it is exposed at Sharpsville was quarried years ago at many places. It is in layers 6 to 12 inches thick, is fine-grained, dark grayish-brown, fairly hard, and makes a good building stone, if the color is not objectionable.

MONROE COUNTY.

With an area of 623 square miles and 28,286 population, Monroe County has 45 people per square mile or seven more than Wayne County. Lying as it does along the Delaware within easy motoring distance of New York City and including within its boundaries a high and wild area with many small lakes and ponds, Monroe County, like Pike County on the north, is much more populous in summer than when the census was taken. Delaware Water Gap and Mount Pocono, well known summer resorts, are in this county.

The rocks exposed in Monroe County are all sedimentary and the geologic section extends from the Oneida conglomerate in Kittatinny Mountain westward from Delaware Water Gap, to the Pocono sandstone in Coolbaugh, Tobyhanna, and Tunkhannock townships. Besides these sandstones at the top and bottom, the section includes the Helderberg limestone, Oriskany sandstone, and the Catskill group with its several horizons of thick massive sandstone and conglomerate. The county was overrun by the glacier and part of its surface is covered with drift which includes boulders large enough to be used for building stone.

The Oneida and Medina are confined to Kittatinny Mountain; Helderberg limestone and Oriskany sandstone outcrop in a narrow belt from Deekers Ferry parallel and close to the Delaware as far as the Water Gap, through Saylorsburg and Kunkletown.

The Catskill beds outcrop along the mountain flank through Merwinsburg and Tannersville, and underlie most of Pocono, Paradise,

Preece, and Barret townships. These beds include the Delaware River flags that are quarried in Pike County and elsewhere.

The northwest third of the county is a high plateau and wilderness of second growth and brush all underlain by Pocono sandstone.

I do not know of a building stone quarry in Monroe County, but I am not familiar with the whole area.

At Stroudsburg the Court House is of buff sandstone possibly from Forest City, and the Methodist Episcopal church (1911) is of buff sandstone from near Scranton. The main wall of Stroudsburg National Bank is of gray and buff to pinkish sandstone and grit, possibly from Ohio.

At Tannersville, which is on the Catskill beds, outcrops of red sandstone and bluestone are abundant, but most foundations are of cobbles from the glacial drift. There are no stone houses in Tannersville and the few barnyard walls are slabby sandstone probably obtained with little or no quarrying. At Scot Run there is one house built of glacial boulders, and a house and small church of dark bluestone dressed to squared blocks.

Mount Pocono has some excellent retaining walls, foundations, and property line walls built of cobbles. The Methodist Episcopal church (1886, rebuilt 1911) was built evidently of glacial boulders that were broken to the size desired. The stone is a motley assortment of red, blue, green, and buff sandstone and grit, with both fresh and weathered surfaces exposed. The Chevrolet garage is of the same material but a better-looking job. Some of the red and green sandstone in these walls would be very nice building stone if occurring in a sizable ledge.

Tobyhanna, a small village halfway between Stroudsburg and Scranton, is graced by some exceptionally good masonry in the Roman Catholic church, the home occupied by Father O'Malley, and the wall surrounding the property. This is red Pocono sandstone and grit dressed to neat blocks and laid with care. The stone was obtained from large loose blocks lying on the surface along roads and trails in the military reservation just west of the village.

According to I. C. White¹ the Bossardville limestone was quarried in several places and burned for agricultural and building lime, but he does not mention its use for building stone. Its flinty and shaly characters probably make it undesirable.

White describes the Oriskany sandstone as pebbly, 20 feet thick, making ledges and strewing the surface with loose blocks. Although the rock is hard and difficult to work it was quarried to procure stone for the N. Y. S. & W. R. R. bridge across Brodhead Creek. Half a mile below, the hard, pebbly, calcareous sandstone at the top of the Oriskany beds was quarried on top of the bluff about 1855 for piers of the D. L. & W. R. R. bridge over Brodhead Creek. He says "Granite could not be more difficult to dress into shape than the blocks from this stratum, and except for the fact that the joints run very straight and thus give two very nearly smooth faces to the stone, it would be almost impossible to work it except at great expense."

Of this same sandstone at a place in Stroud Township which I think is 2 to 3 miles southwest of Stroudsburg, White says, "the Oriskany sandstone comes upon the north face of Godfreys ridge, half way be-

¹ White, I. C., *The geology of Pike and Monroe counties: Pennsylvania Second Geological Survey*, Rept. G6, 1882.

tween its crest and the valley of McMichaels Creek. It rises in a lofty cliff locally known as Mt. Granite from the hardness of the stone which is quarried there. The color is a grayish-brown, and the rock is filled with fossils, principally large Spirifers. From this locality was procured the stone used by Col. Norton in the construction of his residence and surroundings."

At the time of the Second Survey, grayish-green flagstone 2 to 4 inches thick occurring at various horizons in the Catskill beds were being, or had been, quarried on Marshall Creek, at several places on Brodhead Creek between Analomink and Canadensis, and on West Branch of Brodhead near Henryville. The flags were smooth, of excellent quality, and were shipped to Scranton and other railroad towns as well as being used locally.

A large quarry at Analomink, with a face 600 feet long and 150 feet high, is in hard sandstone or quartzite with interbedded shale. It has been operated exclusively for crushed stone, largely for railroad ballast.

MONTGOMERY COUNTY.

Lying west of Philadelphia County and along Schuylkill River, Montgomery County was the scene of military encampments during the Revolutionary War and includes the camp ground at Valley Forge just within its border. The county extends from the suburbs of Philadelphia at Chestnut Hill, far up Perkiomen Creek to East Greenville and Palm.

The whole northern two-thirds of the county is underlain by sandstones and shales of the Triassic formation. The lower end of the county, however, is geologically rather complicated. An irregular line through Port Kennedy, Bridgeport, Fort Washington, and Morganville separates the red Triassic area from the much older rocks that are found in the Philadelphia district. South of this line is the limestone belt from King of Prussia through Conshohocken, Plymouth Meeting, and Oreland and terminating near Willow Grove. East of the Schuylkill this limestone is flanked on both sides by ridges of Chickies quartzite. This formation, which in this region is in places, or in part, a sericitic quartz schist, extends from Spring Mill through Edge Hill and Hillside to Willow Grove and thence west to Fort Hill. It also underlies the high ridge at Valley Forge.

A long irregular area of Baltimore gneiss extends west from the easternmost corner of the county through Bethayres to Glenside and beyond. A narrow band of Chickies quartzite paralleling a narrower band of limestone extends east from Bethayres to the county line.

Gabbro occurs near the eastern corner of the county from Woodside to Sorrellhorse and also in the south corner. Granite gneiss is found around Merion Station, Academyville, and Cynwyd.

This leaves an area south of a line from Bryn Mawr, just north of Chestnut Hill and Jenkintown, to Philmont that is underlain almost exclusively by Wissahickon gneiss. An exception is small areas of serpentine near Gladwyne and Lafayette in which several quarries have been opened. The area of Wissahickon gneiss therefore includes the country from Bryn Mawr to Narberth and West Manayunk, around Chestnut Hill, Jenkintown, Cheltenham, and Rockledge.

The quarries in the Triassic area will be mentioned first.

Triassic sandstone.

Four large quarries at Green Lane and Perkiomenville are producing crushed stone only. The rock is a fine-grained Triassic sediment that has been made extra hard, perhaps by the heat of a diabase intrusion. Building stone is not produced. These rocks are so closely jointed that they break in small fragments, and the color is variegated.

Harleysville. One mile west of Harleysville on the creek bank, E.



Fig. 118. Triassic black sandstone from Landis quarry in Christ Lutheran Church (1911), Mainland, Montgomery County.

A. Groff opened a quarry about 1926, in a fine grained hard rock that looks like baked shale. Bedding has a low dip and jointing is not so close but that natural squared building stone could be produced. The color however, is dark to black. In October 1927 the quarry face was about 50 feet high and in two benches. The product is all crushed stone.

Mainland. Between Mainland and Lederachs is the quarry of the Landis Stone Company, Souderton, in Triassic sediments dipping NW. 15°. The upper beds are reddish but most of the quarry is in green to blue, hard, fine-grained sandstone. Jointing is nearly vertical and far enough apart to yield blocks suitable for building stone. Although the principal business is in crushed stone, considerable rough ashlar from this quarry has been used in Hatfield and Lansdale. Christ Lutheran church at Mainland (built 1911) shows the appearance of this nearly black stone when laid in random ashlar with narrow white pointing. Blocks 6 to 9 inches thick mixed with 2-inch slabs make an interesting pattern.

Souderton. Horace Groman operates a red sandstone quarry on the Montgomery County line half a mile from Souderton, producing build-

ing stone for local use. The beds strike N.60°E, and dip NW. 10°. A ledge about 12 feet thick has been developed by a quarry about 100 feet square. The blocks produced are 2 to 6 inches thick and bounded by joint faces. Many of the bedding surfaces are hardened wavy mud films, but as these are the faces to be covered with mortar when laid in a wall, they do not detract from the value of this stone for building purposes.

At the E. H. Alderfer quarry 1 mile south of Souderton the Triassic bluestone is so much shattered that very little if any building stone could be produced. The product is all crushed stone.

Lansdale. Squire Willard White is working a Triassic red sandstone quarry in the woods west of the cemetery on the southwest edge of Lansdale. Several bungalows near the cemetery were built of this stone in 1925-1927. Quarrying is on a massive bed which dips NW. 15°. This dip carries it below the surface so shortly that development has been along the crop instead of down the dip and the face in 1927 was 250 feet long and 20 feet high. The upper half of this face is 4 feet of soil and 6 feet of shelly sandstone that would have to be moved before development could proceed farther down the dip. Joints are normal to the bedding, so the stone comes out in square-faced blocks.

Schwenksville. Most of the stone walls at Schwenksville are of diabase on which the village is built, but at Pennypackers Mills where the Continental Army camped in 1777, the grist mill and barn are built of sandstone. The mill is stuccoed but the barn is not, and here it is observed that few of the stones are rectangular. Parallelograms, trapezoids, and irregular pentagons are common. Most of the blocks are less than 4 inches thick, a few are 7 inches. Stones apparently thicker are on edge. Across the creek and a few rods below the concrete bridge at the south end of Schwenksville is a quarry having the same kind of greenish sandstone. The face exposes about 25 feet of beds including four or five layers of sandstone, 3 to 5 feet thick, separated by shaly beds. The stone is very tough and does not break in rectangular blocks. The strike is E W., dip N. 18°, and the main vertical joints are N.60°E. This stone might do for crushing, but would not make good building blocks. The quarry has been idle many years.

Graterford. Reddish-brown and greenish sandstone occurring in the Brunswick shale of Triassic age has been quarried at a number of places between Lansdale and Graterford. Many of the farm houses and barns in the fertile valley underlain by the shales are built of stone quarried nearby. In most cases, however, the stone is in such thin and irregular slabs that the masonry makes a poor appearance and so is concealed by a coat of plaster. Building stone has not been quarried near Graterford in recent years, but the presence and durability of brownstone in fairly massive beds is evident.

A dam and mill on Perkiomen Creek, 1 mile above Graterford, were built many years ago of brownstone quarried in the creek bank farther up stream. The original dam is gone and the present low dam is on the site of the old plank road below it. The old stone mill has been converted into a residence by Dr. Hiram R. Loux, Philadelphia, but the masonry arches of the penstock attest the good character of some of the local stone. The approaches and abutments of the



Fig. 119. Triassic brownstone in farm house near Graterford, Montgomery County.

highway bridge (Plank Road) at this point are of sandstone from Clearfield County.

The largest blocks of brownstone seen in this vicinity are on the Sisemore farm 1 mile northeast of Graterford and came from a small quarry in the bank of a run about 1,000 feet east of the house. As the run follows the strike of the beds and the dip is NW. 10° into the hill, only the outcrop can be worked without moving excessive overburden. The result is that the stone has been taken for 300 feet along the bank but for only a few feet into it. The massive sandstone ledge is said to be 12 feet thick; only the upper 5 feet was exposed in 1926, the quarry being partly filled and overgrown in the 15 years since it was worked. Vertical joints are from 2 to 10 feet apart.

Stone in the buildings and barnyard walls on the Sisemore (formerly Schwenk) farm came from this quarry. The largest measure 12 by 14 by 54, 7 by 18 by 48, and 11 by 12 by 26 inches. If this bed should be traced to the northeast, doubtless a more advantageous quarry site could be found.

Rahn. Red sandstone was quarried many years ago on the east bank of Perkiomen Creek opposite Rahn, and used in the Oberhouse mill and dam, and in the approaches of the iron bridge over the creek. The stone is durable and the blocks are not too small.

Collegeville. Evidence of the durability of the local red sandstone or brownstone is to be found at Collegeville. Here where the Philadelphia-Reading highway crosses the Perkiomen Creek, a tavern was built in 1701 of brownstone quarried nearby. It is still used as a tavern and bears a sign "Oldest hotel in America, established 1701." The walls are plastered so the masonry cannot be seen, but the five-arch stone bridge here has been subjected to more wear and exposure



Fig. 120. Triassic brownstone bridge (1799) over Perkiomen Creek, Collegeville, Montgomery County.

than the hotel, and the brownstone blocks of which it is built are in fine condition, although the creek has bathed the footings since 1799 and many times in flood has scoured the arches. Some of the stones are pitted one-eighth inch but not spawling. Stalactites 3 inches long hanging in the arches probably are derived from the lime mortar.

Pottstown. According to William L. Hampton, a contractor and builder, the older brownstone buildings in Pottstown, like the Lutheran church built about 70 years ago, and the First Methodist Episcopal church (1869) are of the stone obtained by breaking up boulders on the near by hills, there being no regular sandstone quarry near Pottstown. Part of the stone for an addition to the Lutheran church in 1927 was obtained the same way, by breaking boulders found in the woods. I saw very little spawling in this church; in the Methodist Episcopal church some blocks are slightly pitted where pebbles have worked out.

Sanatoga. At Sanatoga station below the park 2 miles east of Pottstown, John Geugler opened a quarry in the spring of 1926 for the production of crushed stone. It is in hard, ringing, gray Triassic sandstone in slightly arched beds. Some of the beds break naturally in slabs 4 to 8 inches thick and these are sold for building stone. Being on a hard-surfaced highway and only one-eighth mile from the Reading Railroad, the quarry has excellent shipping facilities. Building stone from this quarry has been used in Sanatoga and at Ursinus College. Pyrite crystals occur in this gray sandstone and it is probable that it will weather to a light tan. The production of building stone however, is only a minor part of the business. The crushed stone is approved by the State Highway Department. Quar-

rying is done with steam tripod drill and powder; the crusher and screen also are driven by steam power. Building blocks are from the larger lumps not shattered by explosives.

A black carbonaceous bed 6 to 8 inches thick occurring in this quarry looks like coal but proves to be only a carbonaceous shale in which movement under pressure has produced abundant slickensiding. The slick polished surfaces in the shale are no indication of coal.

Ambler. The principal source of stone at Ambler has been the Lindenwall quarry on the Mattison farm on the edge of town. When seen in 1927 the quarry was more or less circular, about 500 feet across, exposing 15 to 20 feet of horizontally bedded sandstone above the water that covers most of the pit bottom. There is an overburden of 5 to 10 feet of sand. The product is gray and pinkish sandstone that breaks out in very irregular blocks but will dress as desired. A stone crushing plant has long been idle, and it is understood that the quarry is operated intermittently for private interests and not to supply public need. Two other quarries near Ambler in the same ledge have long been idle. The Wyndham Hotel at Ambler, the First National Bank, Opera House, stores and houses are many of them built of this gray and pink Triassic sandstone. Trinity Memorial Church (Protestant Episcopal) was built by Mr. Mattison in 1898 of slightly

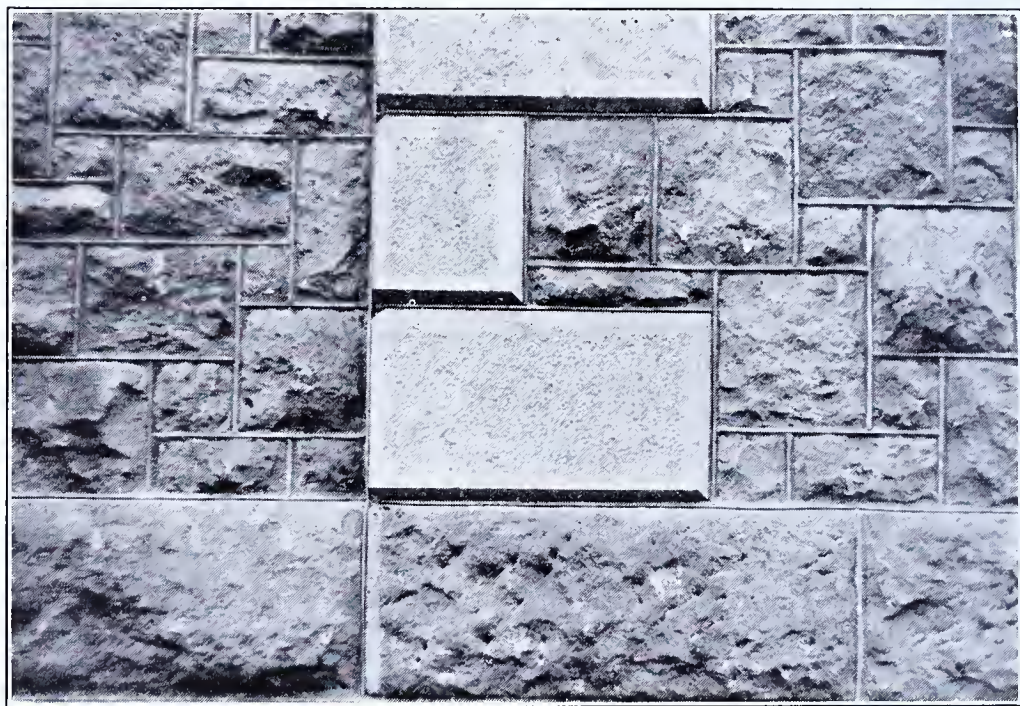


Fig. 121. Rock-face and dressed Triassic sandstone, First National Bank, Ambler, Montgomery County.

reddish and conglomeratic sandstone from the local quarry. This edifice shows how the stone can be dressed and carved, its durability and the darkening effect of weathering, but in the minds of some people, is over-ornamented with cut stone. The bank building shows a color contrast between rock-faced walls and the tool-dressed corner quoins.

Triassic sandstone has been quarried also at several other places in the county, but most of them are small openings for local use only and all have long been idle.

Limestone and Marble.

The limestone of Chester Valley has been dug mostly for lime, and in recent years for crushed stones, but there was a time when it was quarried for building and ornamental stone, especially at King of Prussia and Marble Hall. This Shenandoah limestone of Cambro-Ordovician age is crystalline and in some places is white, blue, or blue-lined marble.

According to the First Pennsylvania Geological Survey (1858) marble quarrying near Norristown began about 1780-85. The largest quarry prior to the Civil War was that at Marble Hall which is in strata dipping S. 20°. The opening is about 400 feet long and 60 feet wide. It is said to have penetrated to a depth of 265 feet and it was at that depth that the blocks representing the Commonwealth of Pennsylvania and the city of Philadelphia in the Washington monument



Fig. 122. Marble quarry 268 feet deep, Marble Hall, Montgomery County.

at Washington, D. C. were taken. One end of this quarry is close to the road through Marble Hall but it is so overhung with trees that the casual passerby might not see it nor suspect the narrow pool to mark an historic industry. The pure white stone here is 5 to 8 feet thick, and the pure white and clouded together about 20 feet. This marble was used for monuments and the finer architectural purposes. About 300 yards south was a quarry on 22 feet of blue marble and 8 feet of black marble, and $\frac{3}{4}$ mile north from Spring Mill were others in clouded marble.

West of the Schuylkill near King of Prussia are other quarries that were mentioned in the First Survey report of 1858. One of these, the old Henderson quarry, was mostly in blue marble but

had some pure white. The long narrow cuts, now full of water, are said to be very deep. The early operators used to saw and plane their product, but Thompson-Weimman & Co. bought the property in 1926, built a pulverizing mill here in 1927 and is mining white marble which is made into whiting and filler for rubber and linoleum.

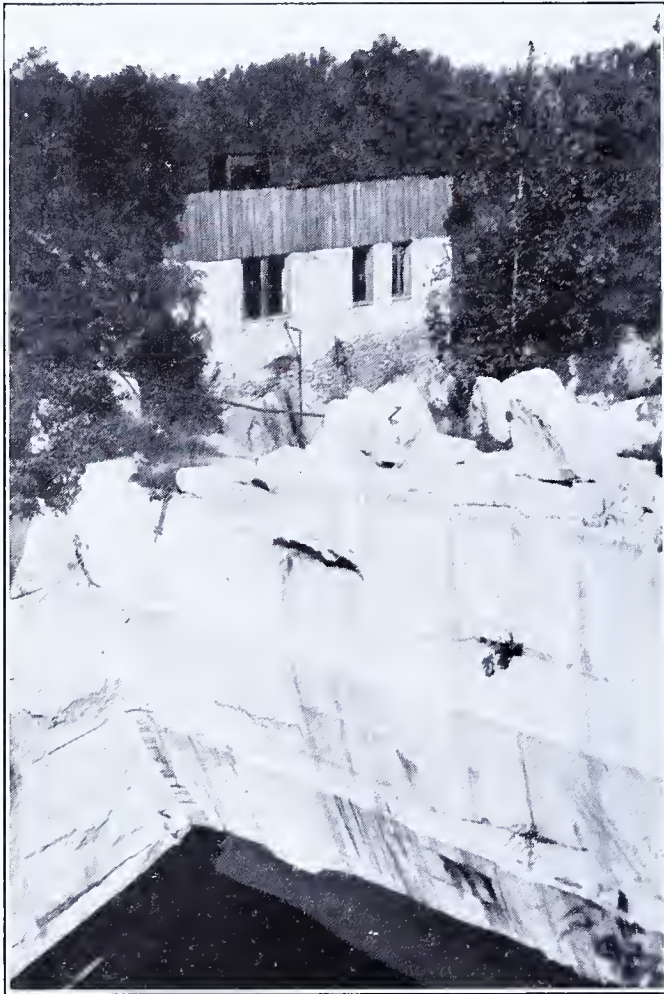


Fig. 123. White marble quarry, King of Prussia, Montgomery County.

Lukens & Yerkes of Philadelphia are producing crushed white marble at a large deep quarry near Henderson that was formerly worked for flux. They could get out white and blue marble for building purposes.

A mile west of Henderson and nearly a mile southeast of King of Prussia is a marble property last worked about 1908 by Schwyer & Liess and now owned by Mr. Chase. It includes one large pit, the second level of which, now flooded, is 100 feet wide and 200-300 feet long, and equipped with a crusher and bins. Part of the quarry face was channel-cut and part blasted. On this property also are two square holes measuring about 50 feet on a side, all cut with a channeling machine, and a marble mill building on the quarry brink, where the white marble was sawed and polished. These holes also are flooded. The beds pitch at a high angle.

Marble for building and ornamental purposes probably has not been quarried in Montgomery County in the last 20 years.

Chickies quartzite (Edge Hill stone).

In Montgomery County the Chickies quartzite is in part a true quartzite and in part quartz-sericite schist or itacolumite. It has been quarried in several places, particularly near Edge Hill, where



Fig. 124. Quarry in sericitic quartz schist (Chickies formation), Edge Hill, Montgomery County.



Fig. 125. Sericitic quartz schist used as building stone at Edge Hill.

the bulk of the material has been sold to steel mills for furnace lining. Both the quartzite and the harder schist are used for building stone. Three miles northwest of Chestnut Hill at Williams is the W. B. Castle quarry with a face about 350 feet long, up to 70 feet high, in beds pitching about 75° . In 1927, 6 to 8 men were employed getting out grayish green, light, dark, buff, and red-stained quartzite for building stone. The spalls were crushed for road metal. The stone breaks naturally in slabs with square joint faces. The public school at North Wales was built of this stone in 1927 and Castle's house 200 yards southwest of Broadaxe. The red and buff-stained blocks laid with thick red mortar joints make a pleasing appearance, for it is lighter than brownstone.

At Edge Hill, Frank Ciocca in 1927 had 6 men in a large old quarry barring down and sledging large blocks into slabs suitable for building stone. The rock splits 2 to 8 inches thick. Bedding is vertical. This stone in newly-built houses in Edge Hill has a neat appearance, and pleasing light color.

William T. B. Roberts & Son have worked two quarries in this stone half a mile northwest of Welden. The larger is 400 feet long and has been excavated 75 feet deep on a soft belt for refractory material. The next belt is hard, bluish, and makes slabby building stone. When this is reduced to road grade the land will be sold for building lots.

A mile farther east along this ridge near Abington this light colored sandy sericite schist in thin vertical beds has been quarried in two or more places for building stone and other uses. These quarries of the Edge Hill Stone & Construction Company were idle when seen in 1927.

Baltimore gneiss.

In the large area of Baltimore gneiss extending from the eastern corner of the county to Glenside and beyond, and from Bethayres north to Byberry, I know of only two quarries. These are just above Bethayres and at Paper Mills on Pennypack Creek. Both of these



Fig. 126. Baltimore gneiss in quarry at Bethayres, Montgomery County.

quarries supplied much stone for Bryn Athyn Cathedral now building on the hill near by.

Bethayres Quarry Company employs about 20 men in a hill-face quarry with a face about 300 feet long and 60 feet high. The product is rough building stone and crushed stone. As the sheeting is vertical and the stone variable, different parts of the quarry yield light gray and tan, striped black and white to nearly black stone. It is typical Baltimore gneiss with pronounced gneissoid structure and blue quartz in most of the rock. All deliveries are by truck although the quarry is directly on a railroad.

The other quarry is a pit beside the road on the east bank of the creek at Paper Mills. Operation had been discontinued when seen in 1927 because as reported it had been depleted of stone suitable for use in the cathedral near by.

About $\frac{3}{4}$ mile farther up the creek on the Mann farm, now owned by Mr. Raymond Pitcairn, large residual boulders on the bank and in the flood plain of the creek were broken up for ornamental carv-



Fig. 127. Church of the New Jerusalem, Bryn Athyn, Montgomery County, in part of Baltimore gneiss from Bethayres. Trim is sandstone from Bowling Green, Kentucky.

ing on the exterior of the cathedral. This is a pink and green, coarse-grained granitic rock, perhaps intrusive in the Baltimore gneiss. I have not seen it in outcrop and know nothing of its occurrence except these large boulders. Life-sized human figures were carved in it for ornamenting the choir cloister, and the abundant pink feldspars give a flesh tint. If this stone could be found in abundance on land where quarrying could be done advantageously, I believe it would be worth developing for structural and ornamental purposes. The polished stone should be especially attractive.

The cathedral referred to above is the Bryn Athyn Church of the New Jerusalem (Swedenborgian), just north of Huntingdon Valley and about 14 miles northeast of the City Hall, Philadelphia. Its location on high, level land overlooking the valley of Pennypack Creek makes it visible from a distance and the size and perfection of the edifice make it particularly notable. Begun about 1913 by the Pitcairn family of Pittsburgh, with time and cost no object, but with perfect craftsmanship required, the cathedral after 18 years is an imposing structure, but as ideas change or new ones develop, parts are altered or new ones added and construction may continue for 50 years. All stone is delivered rough and finished on the job; the colored glass windows, the hardware, electric fixtures, and carved woodwork are all made on the spot. The exterior walls are from several sources; some walls are stone from one quarry, some contain stone from several quarries. Besides the quarries near by at Paper Mills and Bethayres, which furnished large quantities, granite came also from East Weymouth, Mass., Westerly, R. I., and Seisholtzville, Pa. Much of the exterior trim is limestone from Bowling Green, Ky., and interior walls and columns are mostly Cleveland, Ohio, sandstone, all hand dressed. The floor of the main aisle of the church and the roof of a tower are weathered, natural-face Plymouth granite from East Weymouth, Mass.

The stone mosaic floors, curved stone staircases, and statuary produced by 20 or more stone cutters on the cathedral grounds should delight the eye of anyone interested in such matters, and the whole structure appeal strongly to masons and church architects.

Wissahickon gneiss.

Although the Wissahickon gneiss underlies a considerable area in the southeast part of the county, there are few quarries in it considering the density of population and character of building. The Philadelphia folio shows one at Ogontz, one south of Narberth, one east of Haverford, and two on Mill Creek that I have not seen but they are not recorded as being worked recently. The largest group of quarries is in a half-mile stretch along a creek that mouths at West Manayunk. Here along Rock Hill Road and below the State Road are the P. J. Lawler quarry on the left, McCabe on the right, and farther down stream the Smith quarry. They vary in size. Smith's the largest, having a face 700 to 800 feet long and 100 feet high. The bedding dips northwest; large and prominent rusty joint faces are nearly vertical. The rock cleaves in slabs 2 to 5 inches thick. Although the rock is called Wissahickon gneiss, the product of these quarries includes coarse- and fine-grained gneiss, some prominently banded and some not, some very micaceous, and so-called bluestone, which is bluish-black, fine-grained hornblende schist. Pyrite is abun-

dant in some beds. All quarrying is by hand labor and delivery by truck. The Smith quarry has a steam power rail crane for moving waste and for loading trucks. Much of the product is used for rubble foundations and backing, but some is used for face stone, either the iron-stained joints or fresh black faces being exposed.

At Hill Crest, two miles west of Jenkintown, are operations in the woods near the cemetery of the Holy Sepulcher. In 1927 all were quarrying gneiss and some of the stone was being dressed in the quarry. Roman & Felix employed 5 men in one end of the Waverly quarry, and A. Vecchione in the other end. The whole quarry is about 300 feet long with a face 25 feet high. The product is all



Fig. 128. Gneiss quarry at Hill Crest, 2 miles west of Jenkintown, Montgomery County.

rough building stone and includes sandy gray and blue gneiss and very micaceous schist. In an adjoining quarry, but in higher beds Marcolina Brothers employ 10 men. The ledge is drilled and shot down, and for rubble the larger blocks are mated to 2-men size. Three men were preparing dimension stone in the quarry, 6-foot door stones, etc. The product is mostly micaceous schist but includes some gneiss or bluestone.

MONTOUR COUNTY.

In area Montour County is next to the smallest in the State, having 130 square miles as against Philadelphia County's 128. It is fairly populous, however, with 111 people per square mile. It was separated from Columbia County and lies between it and Northumberland County.

Geologically the county is underlain largely by Devonian sandstones and shales of Hamilton-Chemung age. Two anticlines bring up Clin-

ton beds and are flanked by outcrops of the Helderberg limestone and Oriskany sandstone. The northern anticline brings the Helderberg limestone to the surface in Limestone Township; the southern anticline crosses the county in an east-west course and the limestone and Oriskany sandstone follow direct courses, one of which is through Mooresburg and Mansdale and the other from Danville east through Frogtown and Ridgeville. The Clinton red and green shale beds lie between these bands of Helderberg limestone, and west of the limestone that crops out in a crescent from California to Limestoneville.

The building stone available within the county is therefore confined to the Helderberg limestone and to the sandstones in the short geologic section exposed, extending from the Catskill to the Chemung formation.

The only building stone quarry that I have seen in this county is about 2 miles east of the Danville business district and one mile east of the State Hospital. It is known as the Pineo quarry and on the Philadelphia & Reading Railroad. The rock is a dark bluestone in the Hamilton formation, it strikes E. W. parallel with the railroad and dips S. 30°. The upper beds are shelly but the lower ones are massive and tough, and much building material has been taken from them. The stone tends to break with square straight faces and to become rusty on long exposure.

Stone Buildings.

Danville is the county seat, and with a population of 7,000 is by far the largest community in the county. It contains a number of stone buildings, some of which are mentioned in the following paragraphs.

The large main building of the State Hospital, although faced with stucco, was built of bluestone from the Pineo quarry 1 mile east. Some smaller buildings, including the laundry, fire house, and root house are of the same dark sandstone. The stone from the Pineo quarry is durable but the walls of it are dark, with a rusty tinge. The office wing is yellow Ohio sandstone with trim and porte-cochere of Hummelstown brownstone.

Geisinger Hospital is largely brick; the original building has foundation and trim of sandstone from Berea, Ohio, and the newer buildings are trimmed with Indiana limestone.

The Thomas Beaver Free Library (1886) is gray Ohio sandstone (Euclid bluestone) with small red Scotch granite columns at doors and windows.

The Y. M. C. A. building adjoining the library is of the same stone. Here it is evident that some of the sawed faces are spalling. Mostly the stone blocks are clean, but a few have developed noticeable black spots.

Christ Church, Episcopal (1881) is built of gray sandstone from Shickshinny in rock-face random ashlar. Many blocks are now potblack and their abundance and irregular distribution detract from the appearance of the building. As this discoloration is derived from the atmosphere and only a surface manifestation it could be removed by sand blasting. A thorough cleaning would greatly improve the external appearance of the building. The trim is a softer yellow sandstone from Farrandsville, above Lock Haven, and the tracery window frames are yellow Ohio sandstone.

St. Paul's M. E. Church, front and tower (1900), exhibits a green sandstone from Central, which is in the upper end of Columbia County, and Indiana limestone trim; also two small columns of red granite.

The Danville National Bank (about 1881) is yellow sandstone perhaps of Pocono age, from Farrandsville, above Lock Haven in Clinton County, with an addition on the north of yellow sandstone from Amherst, Ohio. The trim is gray granite.

The First National Bank (1922) is Indiana limestone on a granite base.

The notable house, because built of serpentine, is the one at the corner of Ferry and East Market streets now owned by H. R. Reimard. This house was erected about 1880 and the serpentine is said to have come from near Philadelphia. Most of the walls are rubble masonry but broken ashlar was used in two bays. The serpentine is in good condition and has preserved a good color. The window and door sills and water table are granite from Vermont. This house is somewhat unusual inside as well, for the doors and trim on three floors are black walnut.

The General Daniel Montgomery house at the corner of Mill and Bloom streets was built in 1777 of a dark sandstone said to have been quarried just north of town. The masonry is mostly 2- to 3-inch slabs, with a few large blocks. Weathering has darkened the stone and brought out a rusty color on some. The door steps are from the Pineo quarry, which has produced many large door stones for this town.

The Grove Presbyterian Church on Bloom Street is Shickshinny sandstone trimmed with Hummelstown brownstone, and the Knights of Golden Eagle home, and two houses at Price and Hancock streets are said to be the same material. The Grove Presbyterian Church has a random ashlar front and rubble sidewalls with buttresses. The sidewalls are mostly clean, but the buttresses, which are not protected by the eaves, have many black-faced blocks. The brownstone buttress quoins are black on the upper face and only partly stained on the sides. Many blocks on the front wall that are close to trees are stained black. The evidence points to soot from the air as the staining agent, rather than oil from inside the stone, as has been suggested. The local sandstone is thoroughly durable, but the hodgepodge of black, gray, rusty and tan which develops on long exposure is far from attractive.

At Sacred Heart Villa, which is at the east end of Danville, a high school was erected in 1930. The building is several hundred feet long, two stories, with a high tower. The walls are mica schist from Foxcroft, Delaware County, backed with dark bluestone from the near by Pineo quarry. The schist is laid as random ashlar, with the banding flat and on edge, and interspersed with 1 inch slabs of bluestone. Lintels and window quoins also are of mica schist. Bluestone was used for floors and baseboards.

Much of the flagstone seen in Danville streets came from Pine Creek in the western part of Lycoming County, and the large doorstones and steps from the Pineo sandstone quarry east of town.

Elsewhere than at the county seat stone buildings are rare. A stone house at the Mausdale road forks built more than 100 years ago is of sandy limestone rubble from the near by Helderberg or Lewistown limestone.

NORTHAMPTON COUNTY.

The central county on the eastern border of the State was named from a county in England, and its early settlements were founded by Moravians, Nazareth in 1739 and Bethlehem in 1741. Easton was laid out in 1773. Northampton County contains more than 400 people per square mile and is therefore one of the most thickly populated counties.

The building stone resources are various. Crystalline rocks of both sedimentary and igneous origin, called gneiss, occupy a considerable part of the county south of Lehigh River. Quartzite is found in many places along the edge of the gneiss areas. Limestone of different kinds underlies a broad belt across the county south of a line through Martins Creek, Nazareth, and Northampton. North of this line is the great slate belt, extending from the northern border of the limestone to Kittatinny Mountain, which is made of Onedia and Medina sandstone. Serpentine occurs at Easton, and about 1 square mile at the corner of the county south of Leithsville is underlain by red sandstone and shale of Triassic age.

In the report on the geology of Lehigh and Northampton counties (Report D3, Vol. I.) published in 1883, the limestones, which are of Cambro-Ordovician age, were described as blue, semi-crystalline rock, in places much dissolved and containing bands of calcite in the cracks; in places dove-colored, earthy or compact, sometimes shaly.

The sandstone (called Potsdam by the Second Survey) is hard, compact quartzite of a yellowish color where weathered, and grayish when fresh. It contains small specks of feldspathic material, which weather out* on exposure, giving a pock-marked appearance. It is only about 20 feet thick. According to F. Prime, Jr. (Rept. D3, p. 207) where it is a typical quartzite "it makes a most excellent building stone, no better guarantee as to both its appearance and durability being needed than the main building (Packer Hall) at Lehigh University and those of the Bethlehem Iron Company in South Bethlehem. It is also well adapted to many purposes around blast and reverberatory furnaces."

Concerning building stones in the Allentown quadrangle, which includes that part of Northampton County around Nazareth, Bath, Bethlehem, and Hellertown, B. L. Miller,¹ professor of geology at Lehigh University, has written as follows:

"In many places throughout the quadrangle buildings have been constructed of the local limestones, sandstones, and gneisses, but almost without exception these structures are old, most of them antedating the railroad. For many years no building stone has been quarried in the region other than for foundations. The Whitefield house in Nazareth, begun in 1740, probably the oldest house in the quadrangle, is built of local limestone.

Limestones.

"The abundant limestone strata that underlie most of the valleys of the quadrangle may contain good building stones in some places, but no quarry of good limestone for building is known. There are several reasons for this lack of good stone, the chief of which perhaps are the shattered character of the rock, the irregularity of the joint planes, the curvature of the beds, and the presence of numerous veins of

¹ Miller, B. L. Mineral resources of the Allentown quadrangle: Pennsylvania Topographic & Geologic Survey, Atlas 206, pp. 127-129, 1925.

calcite and quartz. All these features are the result of the intense compression to which these rocks have been subjected at different times since their deposition. Another defect is the irregularity of the beds and their great variation in grain and thickness owing to the frequent recurrence of shallow water during the periods of deposition. Many of the limestones are ripple marked and sun cracked, and thin beds with shale partings or even beds of shale or sandstone alternate with thick beds of limestone. For these reasons rectangular blocks of rock are difficult to obtain without the removal of an excessive amount of waste rock, and the cost of labor required to quarry and dress the stones is prohibitive. Some of the strata in certain quarries might be used to advantage for building and the less desirable stone for ballast or for fluxing material.

“Another objection to some of the limestones for building is their change of color on weathering. Most of the limestones are dolomitic, but the magnesium content differs in the different layers. When fresh the rock is all bluish, but on weathering the more dolomitic layers become much whiter than the others. The limestones that border the cement rocks contain considerable sand in irregular masses and have a tendency to become blotched by weathering, on account of their heterogeneous composition.

“Notwithstanding these objections, however, which spoil them for the better grades of building stone, the limestones of the region have been used in the past for foundations and occasionally for buildings and will no doubt long continue to be quarried for local use.

Sandstones.

“The Cambrian sandstones along the slopes of the mountains have been more extensively quarried for building than any other rocks of the quadrangle. These sandstones are known to the building trade as the Potsdam sandstones or quartzites, although they do not belong geologically to the Potsdam sandstone but to the much older Hardy-ston quartzite. This rock has been extensively quarried along the end of the mountain three-quarters of a mile west of Iron Hill, along the mountain opposite the west end of Calypso Island and farther west, in several places near Aineyville, east and northeast of East Allentown, and three-quarters of a mile northeast of Hellertown. Although the same formation is well developed in other parts of the quadrangle the rocks have been largely metamorphosed in many places to a compact taffy-yellow chert in which all bedding planes have been obliterated and the rock has been locally so broken or brecciated as to be unfit for building stones.

“The Cambrian sandstones that have been quarried are composed of quartz sand and a few pebbles, the largest of which are a quarter of an inch in size, firmly cemented with silica. When fresh the rock is bluish-white in color, but as it contains some finely disseminated pyrite the rock on exposure to the weather, both in buildings and in outcrops, changes to a dull yellowish-gray tint that makes a pleasing appearance. The stone is so compact that it possesses very great strength and does not disintegrate from the action of frost. In the quarries the beds are fairly uniform and in most places are from 10 to 18 inches thick. The joints are regular and readily permit the quarrying of rectangular blocks of suitable size.

“The available quantity of these Cambrian sandstones is small, and several of the quarries were abandoned on account of the exhaustion

of the easily quarried material, yet in other localities near by good stone can still be obtained. In most places the quarries were opened on hillsides where there was little overburden, and the quarries were abandoned when it became necessary to remove much waste rock.

"Many large buildings have been constructed of these sandstones, among which the principal buildings of Lehigh University—Packer Hall, the chemistry building, the library building and the new memorial building—are the best known. Packer Hall, erected in 1869, is the largest building in the region built of this stone.

"Interbedded with the Ordovician black shales and slates (Martinsburg shale) in the northwestern portion of the quadrangle are local layers of brown sandstone suitable for building stone. These beds are most numerous in the vicinity of Kreidersville, where they have been utilized for foundations and for a few barns and houses. The color is objectionable for residences, and the beds are not uniform in thickness or in composition.

Gneisses

"Elsewhere in Pennsylvania the gneisses have been extensively quarried for structural stone, but in the Allentown quadrangle they have been little used, probably in the main because a quarry must be opened at considerable expense before the quality of the rock can be definitely determined. On the surface the gneisses of all kinds are so broken by the action of frost or so greatly decomposed that a large amount of work would be necessary to reach good stone. Below the zone of freezing the stone is broken by joints into large irregular blocks that could be handled only by expensive mechanical equipment. The irregularity of the joints would cause an excessively large amount of rock to be discarded as waste, although this condition may not prevail everywhere. As large quantities of crushed rock for concrete and ballast are required in the industries of the region and in the making of permanent roads, market might be found for the rock that is unsuited for building stone.

"The gneisses of the quadrangle furnish a wide variety of stones, ranging from dark-brown hornblende to light granitic rocks, some of which are beautifully banded and others present a uniform appearance. In general the darker gneisses are more common in the eastern part of the quadrangle, especially in the vicinity of Hexenkopf Hill, and the lighter-colored ones are more abundant in the region between Bethlehem and Vera Cruz.

"The gneisses contain no objectionable minerals except in a few localities, where pyrite is a common constituent. The chemical and physical character of the rocks renders them very durable as building stones under all climatic conditions. The economic possibilities of opening quarries in the gneisses should be investigated."

My own observations on the building stone resources in this county are far from complete.

The gneiss occurring in Lehigh Mountain and in the hills of Lower Saucon and Williams townships is coarse-grained, composed principally of quartz and feldspar, in some cases with small amounts of dark mica and pyroxene. It is deeply weathered, and the alteration of the feldspar together with iron staining gives the rock a brownish cast. Surface blocks have been broken up to provide rough stone for retaining walls, foundations and a few small houses on the hill south

of Bethlehem. Deep excavation probably would be required to find fresh stone.

The Hardyston quartzite occurs in a narrow band along the north boundary of the gneiss through the campus of Lehigh University, in Northampton Heights, in many places on the east side of the limestone valley south and east of Hellertown, in the bend of Delaware River two miles below the mouth of Lehigh River, and on the south side of Quaker Hill. Outcrops of this formation, which is only about 20 feet thick, are not common, but its presence is recognized by float. The only quarry in the Hardyston quartzite that I have seen in this county is at the foot of the hill $\frac{3}{4}$ mile northeast of the business center of Hellertown. It was being worked by Hoffer & Deemer in 1927. The strike is N. S. and the dip $W.35^{\circ}$, or rising with the hill so that loosened blocks slide to the quarry floor. Bedding is thin at the surface but increases with depth to a foot or more. Joints are at different angles, which results in beveled ends on some blocks. Production in 1927 was by barring, and much of the stone, being near the surface, showed tan weathering on the joints. On fresh fracture the rock has a bluish tinge. This stone was being used for the construction of small houses in Hellertown.

Hardyston quartzite was used in several buildings at Lehigh University, including Paeker Hall (1869), Alumni Memorial Hall (1922),



Fig. 129. Hardyston quartzite in Memorial Building, Lehigh University.

Library extension, and Parker Engineering Laboratory (1928), and has proved eminently satisfactory. This stone came from several quarries along the south bank of Lehigh River west of Bethlehem in Lehigh County. By laying the stone with many joint faces exposed, a weathered or old effect is obtained, for the joints are brown with iron stain. An occasional weathered surface is distinctly red. Most of the rock on fresh fracture is gray, though some is almost black. All

of these harmonize and blend so that the appearance of a new wall is pleasing. On the other hand, if fresh faces predominate the effect is bizarre. Coxe Mining Laboratory and Drown Memorial Hall at Lehigh University are built of Oriskany sandstone quarried near Palmerton in Carbon County.

Bethlehem is underlain by limestone and one of the oldest buildings in the county, a Moravian house on Church Street built in 1745, is of this local stone, most of which is dolomite but some blocks are notably sandy. Although the stone dresses rather rough it is durable and weathers to a gray tone. The Bethlehem Trust Company building is Hummelstown brownstone. Opposite Liberty High School are two modern houses built of mica schist, probably from different quarries in the Germantown district of Philadelphia County. In one house most of the slabs are laid flat, but the other has large slabs on edge to show brown weathered and glistening mica surfaces.

In the limestone valley between Bethlehem, Easton, Bath, and Martins Creek, limestone is the principal building stone for farm houses and barns. The front of the buildings or only the corners may be of squared blocks, but the other walls are always of rough stone, for this rock does not break naturally with smooth faces nor dress easily. The weathered surface is gray.

Easton is on limestone and that is the common building stone. Quarries at and below the mouth of Lehigh River with faces 50 to 150 feet high in steeply dipping beds are worked for crushed stone but building stone is supplied on demand. Some of the limestone is coarsely crystalline but much of it is fine-grained, drab, with conchoidal fracture. In Easton one also sees masonry of coarse-grained rough-faced, irregular-shaped blocks of gneiss, that may have come from Chestnut Hill, a ridge of gneiss on the north of the city; also brownstone, gray sandstone, and serpentine masonry.

In Chestnut Ridge just north of Easton and extending from C. K. Williams & Company quarry on the bank of Delaware a distance of 3 miles southwest to Bushkill Creek is a belt of serpentine and tremolite that has been opened by several quarries. Most of the serpentine is in a band about 20 feet wide but narrower bands occur in the tremolite. The better grade of talcose rock is ground to pulp for filler in paint and for other purposes; the serpentine used to be taken out in large blocks and made into polished slabs for interior decoration. This rock is a mixture of light and dark serpentine, some of it streaked with pure white veins of calcite. According to Peck¹, the quarry on the Delaware River road 2 miles north of Easton was opened about 1850 by Abram Sherrer and almost from the beginning the value for wainscoting, mantels, etc., was recognized. In 1898 William B. Reed of Easton formed the Verdolite Company, opened a quarry higher on the ridge and produced rough blocks for a time. About 1905 H. A. Schweyer, of King of Prussia, opened a quarry where the serpentine belt crosses Bushkill Creek, built a mill close by and sold polished slabs of ornamental green serpentine for interior trim. This industry was abandoned several years ago.

In the broad belt of Martinsburg shale which extends across the northern part of the county between Kittatinny Mountain and the limestone valley, and which includes the slate belt, there are two local

¹ Peck, F. B., Talc and serpentine of Northampton County: Penn. Topographic and Geologic Survey Commission, Rept. No. 5, 1911.

sources of building stone. One is the boulders in the glacial deposit that mantels the surface. Many of these boulders are hard quartzite and grit and of such a size that they can be broken and trimmed into building blocks. The foundation of the new high school (1926) at Bangor is of this material taken from the cellar excavation. One boulder was described as being "as big as your car." The colors are blue, gray, drab, tan, and iron stained. Pointed in white mortar, these glacial boulders make a good looking wall. Around Bangor they have been used very commonly for foundations, in some cases squared, but mostly as angular blocks. A small Catholic church north of Portland was built (1925) of selected light colored glacial cobbles set in concrete without reshaping.

Another source of building stone is the sandy or sandstone members in the shale formation. The middle sandy member of the slate belt includes relatively thick beds of blue-gray sandstone which weathers to a buff and is suitable for building stone. Slabs of waste slate are used for retaining walls around the waste piles at the slate quarries, and also for foundations of buildings. Slate flags have been used for sidewalks, steps, and fence posts but are gradually being replaced by concrete.

The heavy-bedded Shawangunk conglomerate and sandstone in Kitatinny Mountain have strewn the surface below the onterop with large gray blocks which only need breaking to be suitable for building stone. A retaining wall along the highway just below Delaware Water Gap may have come from this source, and the stone house and retaining walls just below Lehigh Gap presumably are built of material derived from float on the adjacent mountain side.

NORTHUMBERLAND COUNTY.

Northumberland, the queerest shaped county in the State, lies just east of the center at the forks of the Susquehanna. Sunbury, the county seat, has about 16,000 people, but Mount Carmel has 18,000 and Shamokin 20,000.

The county is crossed by several east-west anticlines and synclines in which the rock formations stand at all angles from horizontal to vertical. The surface has been reduced by erosion to broad low-lying areas underlain by the softer shale formations separated by steep ridges made by the weather-resisting sandstones and conglomerates. The rock formations in this county, in geologic sequence, are Clinton shale, Helderberg limestone, Oriskany sandstone, Hamilton, Portage and Chemung shales and flags, Catskill sandstone, Pocono sandstone, Mauch Chunk shale, Pottsville conglomerate, and Coal Measures.

The building stones therefore are gray and red sandstone, conglomerate, and limestone. The limestone has been burned for building and agricultural lime and crushed for coarse aggregate in concrete, but so far as I have observed, no notable use has been made of it for building stone in recent years. The large blocks of limestone in the railroad bridge piers may be of local origin. (Fig. 130)

Broad areas amounting to about half of the county are underlain by Devonian shales and flags that are not expected to contain building stone, although under unusual conditions the slabby flags may be so used.

At Mount Carmel, which is in the midst of the coal basin, much

of the curbing is red quartzite, probably from near White Haven. A number of stone churches attracted my attention but they are not of local stone. The Lincoln Street M. E. Church was built in 1928 of granite from Mount Airy, N. C. Grace Evangelical Lutheran Church



Fig. 130. Large blocks of limestone used by Reading Railroad in wall at west end of bridge at Sunbury.

(1922) is reddish marble, St. Joseph's Polish R. C. Church (1923) is Holmesburg gneiss, split across the grain, and the First Methodist Episcopal Church (1914) is micaceous white marble probably from Avondale, Chester County, while the adjoining parsonage is white Vermont marble. I did not see any whole buildings of the local sandstone.

Shamokin, also in the Western Middle Anthracite Field, seems to have few stone buildings. St. Edward Catholic Church (1873) exhibits the outcome of using the local Coal Measures sandstone. It dresses fairly well, is durable, and so massive that door steps up to 7 feet long have been cut from it. The blocks in the walls of the church are 8 to 10 inches thick and 2 to 3 feet long. But the stone weathers to a greenish-tan that is far from attractive, and in this church, the front below the eaves is badly soot stained although the tower is clean.

At Treverton an old house and foundations of several others are of native sandstone roughly dressed. The stone has weathered to the unattractive color common to the Coal Measure sandstones. At Raker a few miles farther east the local sandstone in irregular blocks was used for building Emanuel Lutheran & Reform Church (1922). It has a yellowish tint and looks fairly well yet.

An example of what can be done with slabby sandstone float is exhibited at Mandata or Bull Run in the gap of Hooflander Mountain 3 miles southeast of Herndon. Here is a house built in 1927 by Dr. Harvey Klock which to me, is attractive masonry. It is wholly of Oriskany sandstone float in slabs less than 2 inches thick, laid with rounded weather edges exposed, and mortar joints deeply recessed.

The rock ledge at the rear of the house was cut back in grading and did not furnish material for the house itself. This ledge is of dense, hard, blue, quartzose sandstone in beds up to one foot thick but so shattered across the bedding that good building blocks could not be obtained from it. The Oriskany sandstone float is weathered to gray, tan, and pink, and was used in the roadside wall, retaining wall along Fidler Run, and arched stairway leading to the run. The large stones for the path from the gate to the house also came off this property.

Milton on the West Branch in the northern part of the county is very close to a ridge of Helderberg limestone. Some of the earlier buildings, like the H. W. Chamberlin house on the river bank between Fourth and Fifth Streets built in 1794 (remodeled in 1920) and the house at the corner by the end of the bridge, are built of this dark blue limestone, which is a perfectly good building stone. In the last 50 years, however, it has been convenient to bring building stone by rail from the north side of Bald Eagle Mountain opposite Montoursville where the mountain side is strewn with float blocks of Tuscarora sandstone. The First Presbyterian Church (1880) at Milton and the Fonda



Fig. 131. Medina sandstone in Presbyterian Church (1880), Milton, Northumberland County.

residence opposite it are of buff sandstone said to be from Loyalsock Station. Where the brownstone trim came from was not learned. The stones in the church are generally small, mostly under six inches thick, and many of them do not dress truly rectangular, so the courses are wavy. Some blocks are much lighter colored than others and give a mottled effect to the wall. The Methodist Episcopal Church (1882) is of buff to pink sandstone, probably Tuscarora from Bald Eagle Mountain, but the stone is dressed smoother than in the First Presbyterian Church and is not stained so dark, perhaps because the Presby-

terian Church was for a long time heavily covered with ivy. The brownstone trim and bluestone steps of the M. E. Church have spalled but the Tuscarora sandstone in these two churches, and in several porches shows no deterioration.

The Methodist Episcopal Church (1921) on the square at Northumberland is built of reddish granite from Seisholtzville, Berks County. Other than this I observed only nondescript foundations of buff and reddish sandstone.

Sunbury has several stone buildings, one of which is the Northumberland County prison built in 1878 of massive red and green sandstone in coursed ashlar. This looks like the Catskill sandstone and probably came from the hills close to the city. A stone house at Front and Arch streets, built by Wm. Maclay in 1773, and rebuilt in 1888, has a first story of dressed gray limestone in 6 to 8 inch ashlar, weathered to light tan; and a second story of dark sandstone in 4-inch ashlar. On the opposite corner is another old stone house of very dark sandstone with some light-colored blocks mixed in. The stone is durable but the mixture is unattractive. Doubtless all this stone was found within a short distance, unless it was brought here by boat.

The First Evangelical Church (1927) in Sunbury is Indiana limestone, including the six fluted columns, and the steps are granite. The First National Bank is Indiana limestone on a granite base, and first story of the building occupied by the Sunbury Trust & Safe Deposit Company is Hummelstown brownstone. One store on the square has a first floor front of verde antique marble like that from Cardiff, Maryland, and a yellowish-green stone house on the square is built of serpentine, probably from Chester County. Zion Lutheran Church is granite from Seisholtzville, Berks County.



Fig. 132. Seisholtzville granite in Zion Lutheran Church, Sunbury, Northumberland County.

PERRY COUNTY.

Perry, the first county within the mountain belt on the west side of the Susquehanna, by reason of the close folding of the rocks, contains many geologic formations, ranging from Cambro-Ordovician limestone to Mauch Chunk shale. Therefore the variety, distribution and quantity of building stone is interesting, far more so than the uses of it in this rural district. Perry County borders on the Susquehanna from Marysville to Liverpool and beyond, and extends west along the mountains forty miles in the shape of a blunt wedge. The larger settlements, including Duncannon, Newport, New Bloomfield, Liverpool and Marysville are in the eastern end of the county. Some areas, particularly the ridges, have very few residents, and the average population per square mile for the whole county is only 40.

The distribution of the principal sources of building stone is as follows: The Pocono sandstone and conglomerate make Peters and Cove Mountains that enclose the Cove back of Perdix; and also Buffalo and Berry Mountains that form the boundaries of Hunters Valley in Buffalo and Howe townships. Catskill red sandstone underlies the north side of the valley of Fishing Creek from Marysville to Shermansdale and the valley of Sherman Creek from there to the river at Duncannon. Similarly it occupies the valley of Wildcat Creek southwest from Liverpool to the Juniata and the valley of Buffalo Creek west of Newport.

The Oriskany sandstone and Helderberg limestone follow Turkey Ridge on the northern border of the county, Wildcat Ridge and Racoon Ridge east and west of Millerstown, thence zigzag to the vicinity of Blain, follow Buffalo Ridge to Half Falls Mountain, then double back through other ridges, and so loop about until they disappear on the flank of Kittatinny Mountain near Sterretts Gap. The 150 mile outcrop of the Helderberg makes for many small limestone quarries, formerly opened for building and agricultural lime, but little used now.

The Tuscarora or Medina sandstone follows and makes all of the ridges marking the county boundary on the north, west, and south.

On entering Perry County at the southeast corner the first quarry seen is that in Little Mountain at the west end of the Rockville bridge of the Pennsylvania Railroad. It is in the Hamilton sandstone which dips S. 80° and is so broken by straight and curved joints that dimension stone could not be taken here. The only use of this quarry would be as a producer of crushed stone and rubble for rough foundations. The quarry has a face about 300 feet long and 100 feet high, and was worked by the John T. Dyer Co. of Birdsboro years ago. Concrete foundations of the crusher plant are all that remains of the former equipment. This sandstone is dense, hard, and siliceous, and has a light tan color with a greenish cast in the quarry face.

The retaining wall supporting the highway above the railroad around the end of Cove Mountain just above Marysville is built (1921) of large blocks of light cream, pink, and red, coarse grained or conglomeratic sandstone cut from Pocono sandstone float that occurs abundantly on the mountain side. The float rock is abundant through Cove and Perdix and has been used there for rough foundations, fire places, etc. Its most notable use here is in the Blough house and garage at the west end of Perdix. The light cream and pink colors, with here and there

a tinge of red in the fresh broken stone, make a pleasing effect which is retained for many years. The color-effect is like that of the so-called Summerdale stone in Cumberland County.

Pocono sandstone float at Perdix was used for Otterbein U. B. Church, at Peffer and Logan Streets, Harrisburg.

Pocono sandstone also comes to the river in Cove or Peters Mountain just below Duncannon where a considerable thickness of more or less massive, closely jointed, reddish sandstone dipping at high angles is continuously exposed in a road cut. Float blocks from this formation are abundant in the woods on the mountain side and probably furnished much of the stone for old buildings and walls in Duncannon. The small office building built by the Duncannon Iron Company at the south end of the village in 1866, is of Pocono sandstone and conglomerate from float blocks on the near by mountain side. The front of the building is of dressed stone, now too dirty to show the natural color.

At the south end of Duncannon on the north bank of Sherman Creek just above the bridge is an idle quarry in red Catskill flags. The beds are exposed more than 200 feet along the strike and dip S. 35°. Flags were taken here for the village streets many years ago. Four by six feet and larger were raised, but many flags were smaller. This stone is red, medium-grain, and contains small mica flakes. It splits with a fairly smooth surface but rolls make some of the beds irregular in thickness.

New Bloomfield has one mill, one house, and several foundations of gray to pink, coarse sandstone and fine conglomerate probably derived from float on the ridges near by. Mahanoy Ridge at the edge of the town is Oriskany sandstone. On the main highway southwest from New Bloomfield are a few farm houses built with rock gathered here and there on the mountain. It was common to use dressed stone in the front wall and build the rest of the house with rough blocks of any shape.

Andersonburg is in an area of Helderberg limestone and one house there, built more than 100 years ago, is of this light gray stone, taken in the woods on the hill half a mile west.

Blain grew around a mill built by James Blain about 1778. This small settlement has one old and one new stone house, both of mountain sandstone, which here may be Tuscarora. On the mountain west of Blain the Tuscarora sandstone is exposed at the crest and much float lies on the flank. This is a coarse-grained, highly siliceous gray sandstone adapted to building purposes, but most of it in Perry County is many miles from other than truck transportation.

One of the oldest stone structures in Perry County is the Rice mill near Landisburg built about 1786. This old mill still stands, and contains much of the original machinery. The walls are of Helderberg limestone which outcrops here. After the fashion of pioneer mills, the masonry is rough, of many sizes of field stone, but it is durable. Another old stone mill is the Westover or Gibson mill on Shermans Creek 700 yards west of Gibsons Rock. It was built before 1799 of loose stone from the hillside; the frame part of the present mill is a later addition. The mill is now owned by S. V. Dunkelberger.

Several other pioneer mills built in part of stone still stand in the county. The Eshelman or Butturf's mill at Newport, built before 1790; the Endslow mill 1 mile east of Blain, built before 1778; and the

Waggoner mill, first built of logs in 1762 and replaced by the present mill in 1812 on Roddys Run $1\frac{1}{2}$ mile west of Loysville are among the oldest. As I have not seen these old mills any statement as to the kind of stone used and its present condition would be mere conjecture.

The only recent quarrying of building stone in Perry County that I have noted is by Ed Benner of Girty's Notch, who has reopened a quarry 2 miles back from the river in Half Falls Mountain. I have not visited it but assume it is in Oriskany sandstone. The rough stone is hauled by wagon to the Susquehanna and trucked to Harrisburg where it is dressed on the job. Stone from this quarry is soft and sugary when freshly quarried, weathers gray, but fresh faces range from almost white through light buff to pink. Weathering with banded discoloration adds variety to the stone. The Martin Service Station at Heckton, Dauphin County, is built of this stone.

Along the Susquehanna above Clarks Ferry some houses and barns evidently are of field stone or hill float for the masonry includes red, buff, and greenish sandstone blocks of rather small size. These probably come from the Catskill and Chemung-Hamilton formations. A house at the south end of Liverpool and another at Montgomery Ferry, built many years ago are examples of the use of this material.

At Millerstown are several old houses built of rough-dressed sandstone probably of very local origin, from the Oriskany or Clinton beds that crop out close by. In 1925 T. C. Kershner built a house at the west end of the village of dressed sandstone from Peck's land at McAlisterville, in Juniata County. The blocks of rough mountain stone, probably Tuscarora sandstone, were dressed on the job, and make an attractive wall, for the fresh faces show a variety of colors, as tan, pink, bluish gray, and iron-stained. Some blocks have impressions of fossil crinoid stems, spirifers, and other shells. The general effect of the new wall is light tan with a few light gray blocks. The ashlar are mostly 6 inches thick and up to 18 inches long.

PHILADELPHIA COUNTY.

Philadelphia City is coextensive with the county. With an area of 128 square miles and a population of nearly two million, it has an average of well over 15,000 persons per square mile. As clay was readily available at the site of the earliest settlement, many of the oldest houses are built of brick. Good building stone outcrops along the Schuylkill above the Zoological Garden and as the settlement grew this source of building material was utilized. Eventually many quarries were opened in the outlying districts but as the city has grown, these earlier quarries have been filled or leveled and built upon. To-day most of the active quarries are several miles from City Hall and some of them will shortly be sold for building sites.

The greater part of the bedrock exposed in Philadelphia County is a formation known as Wissahickon gneiss. It is a banded quartz-feldspar-mica rock that has various phases, ranging from coarse-grained and quartzose gneiss to highly micaceous schist. It is well exposed throughout Fairmount Park, in Germantown, Chestnut Hill, and north-east through Fox Chase and Bustleton.

A small area of granite gneiss occurs at Upper Darby and was quarried at several places on East Branch of Indian Creek. Over-

brook also is on granite gneiss and a mile long belt of it lies northeast of Fox Chase. A band of hornblende gneiss 3 miles long and less than $\frac{1}{4}$ mile wide lies west of Bustleton, and a belt of Chickies quartzite or Edge Hill stone crosses the corner of the county north of Somerton and has been quarried there.

A very narrow band of serpentine follows a road and stream northeast from Manatawana across Wissahickon Creek, and there is a small area of gabbro in the corner of the county northwest of Upper Darby.

Most of the quarries now working are in the Wissahickon gneiss or Chestnut Hill stone. Because of its accessibility and cheapness this stone is widely used throughout the more recently built parts of the city and even is shipped out of the State. The mica schist phases are so soft that they might seem unsuited to construction purposes, but this rock is insoluble and when placed in a wall will remain unchanged for centuries.

West Philadelphia. Several quarries in the corner of Philadelphia County near Upper Darby have been opened and operated by Thos. P. Lee, 5629 Cherry St., West Philadelphia. These are at 57th and Stewart Sts., 66th and Vine Sts., 68th and Malvern Sts., and 71st and Haverford Avenue. The Vine Street quarry in hard massive coarse augen gneiss has been abandoned and is being filled with dirt from near by grading operations. A quarry at 72d and Malvern Sts. also has been abandoned as it is now in the park system.

A quarry in granite gneiss at 71st and Haverford Avenue was being operated in 1927. It is about 400 feet long and 50 feet deep. As quarrying proceeds on one long face, filling advances on the other. In the lower part of the quarry joints up to 20 feet apart allow for the removal of large blocks, but for the most part sheeting and jointing are closely spaced and irregular. The product is rough and squared build-stone, and crushed stone. Most of the quarry is in bluish granite gneiss, but some of the rock is very light colored. A few small pegmatite veins are injected in the granite. A dozen men are employed. Near by is a Catholic high school built entirely of gneiss obtained in grading and excavating the cellar for the building.

Germantown. John De Filippo, 2935 Van Pelt St., Philadelphia has been quarrying coarse grained micaceous granite gneiss, a phase of the Wissahickon gneiss, at East Clevinger and Chew Streets, Germantown since 1920. The stone raised in grading for houses and excavating for cellars has been used for foundations and first story walls.

J. W. Fowler, Germantown, in 1927 was taking out the last of the available stone in a quarry near Johnson and Chew Streets that has been operated for many years. Property limits have been reached and the floor of the quarry, 30 feet below the surface, is near ground-water level, so this operation has terminated. The stone is mostly coarse mica gneiss with a bluish tinge, with some light-colored bands parallel to the sheeting.

At Stanton Avenue and Washington Avenue, Germantown, quarries that have supplied much stone for local building are now worked out nearly to property lines and operation may soon be discontinued. John Mercurio and Joseph Canoz are the contractors, producing "blue-stone," a phase of the Wissahickon gneiss. A quarry operated by A.



Fig. 133. Quarry of the Chestnut Hill Contracting & Gray Stone Company, Germantown Road and Mermaid Lane, Chestnut Hill, Philadelphia County, in Wissahickon gneiss.

C. Emlen at the same place in coarse mica gneiss, some with pink feldspar, employs 4 men and has much stone yet available.

Chestnut Hill. At Germantown Road and Mermaid Lane, the Chestnut Hill Contracting and Gray Stone Quarry Company employs 10



Fig. 134. Mica schist phase of Wissahickon gneiss in Presbyterian Church, Mt. Airy, Chestnut Hill, Philadelphia County.

men at hand labor quarrying rough building stone. Sheeting dips about 50° (See Fig. 133). The stone is a gray mica schist phase of the Wissahickon gneiss. This quarry was opened 40 years ago and has furnished material for the walls of many buildings in Philadelphia County, and for Rockefeller Hall and the Library at Bryn Mawr College. A very recent construction is the new wing of the Mt. Airy Presbyterian church, Germantown Road and 71st Street. Here the gleaming mica surfaces of the new work are in contrast with the stone in the main building which has become soiled since placed in 1901. Dimension stone can be made at this quarry. When the writer was



Fig. 135. Block of Wissahickon gneiss (mica schist phase) 12 by 2 by 1 feet from quarry at Mermaid Lane and Germantown Road, Chestnut Hill, Philadelphia County, operated by Jerry O'Neill.

there in July 1927 a stone 12 by 2 by 1 feet had been dressed. Rough stone was being shipped that month to Detroit, Michigan. Mica schist from Chestnut Hill has been used for three residences in the 2900 block on North Front Street, Harrisburg, since 1925.

The Comly quarry at Wyndmoor station on Willow Grove Avenue in Chestnut Hill, was sold in 1926 by H. S. Comly to Walter A. Dwyer who has leased it to an Italian contractor. This old quarry, occupying most of a city square, has been worked in four benches producing different kinds of mica gneiss, fine and coarse grained, gray and blue. The present lessee has opened a new pit and is getting out gray stone for facing and rough coarse mica schist for foundations. Some of the rock splits in long pieces and is piled in the quarry like cordwood. Eight men are employed at hand labor. Like the other quarries in Chestnut Hill, this stone is a phase of the Wissahickon gneiss.

Holmesburg. At Welsh Road and Crispen Streets is the large quarry developed by the Holmesburg Granite Company, and now owned and operated by the Holmesburg Concrete Company. The land here was sold in building lots 35-40 years ago but only 2 or 3 houses were erected. Good building stone was found in digging the cellars. Later when the lots were sold for taxes the Granite Company bought them in a block of several acres, moved off the houses, and opened a quarry. The stone

proved to be desirable, operation has continued, and the quarry now is a large elliptical pit measuring about 680 by 550 feet, with vertical walls 100 feet high. The rock is granite gneiss in sheets that increase in thickness with depth. Sheeting is nearly horizontal. In 1927 a broad sheet unbroken by joints, and the sheet just above it, of which a small area remained in one end of the quarry, was 16 feet thick and



Fig. 136. Quarry in Wissahickon granite gneiss, Holmesburg, Philadelphia County. This photograph shows the nearly horizontal sheeting, and the great thickness of blocks; also the freedom from joints.



Fig. 137. Curbstone made from granite gneiss, quarried at Holmesburg, Philadelphia County.

with no joint between the side walls of the quarry. The few joints apparent in the upper walls are not quite vertical and fade out above the quarry floor.

After being broken out from the bed by drilling and light blasting the rock is moved by derrick to position under one of the cables thrown across the quarry, and then hoisted and moved to the surface by a carrier running on the cable. The rock is made into curbing up to 13 feet long, into building stone, and paving blocks, and into crushed stone. Rock from this quarry was used in the Portsmouth Navy Yard, New Hampshire, in the Union Station, Washington, D. C., and in public buildings, dwellings, bridges, and other masonry constructions in the Philadelphia district. The Masonic Home at Elizabethtown, Pa., and the Memorial Chapel at Valley Forge are built of stone from this quarry, with Indiana limestone for trim.

Other buildings wholly or in part of granite gneiss from this quarry at Holmesburg include:

Pennsylvania

Ardmore: Lower Merion High School, 1926
 Bryn Athyn: Harold Pitcairn residence, 1927
 Byberry: Philadelphia Hospital, 1924
 Cromwell Heights: St. Elizabeth's Convent, 1927
 Easton: South Side Methodist Church, 1923
 Holmesburg: Community Building, 1923
 Mt. Carmel: St. Josephs R. C. Church, 1923
 Philadelphia: All Saints Parish Parochial School, 1922; Oak Lane Baptist Church, 1922; Mechanics Training School, Girard College, 1925; Sisters of Nazareth Convent, 1927; Wissinoming M. E. Church, 1927; Lady of Consolation School, 1928
 Tacony: St. Huberts R. C. Parish School, 1925

Delaware

Wilmington: St. Stephens E. L. Church, 1927

New Jersey

Audubon: Trinity Lutheran Church, 1927
 Butler: St. Anthony's School, 1927
 Collingswood: St. John's R. C. Church, 1925; Parish House, 1926
 Daretown: Public School, 1926
 Glassboro: Sewerage Disposal Plant, 1926
 Long Branch: Star of the Sea Church, 1928
 Pensauken: Filtration Plant, 1926
 Swedesboro: St. Joseph's R. C. Church, 1925
 Trenton: Church of the Holy Angels, 1926; Church of St. Peter & St. Paul, 1927
 Vineland: Sacred Heart Convent, 1927
 Wildwood: St. Ann's School, 1926

Tests of the crushing strength of Holmesburg granite made in 1902 by Lathbury and Spockman showed 24,034 pounds per square inch when the rock is on edge and 26,254 pounds on the bed.

The stone from this quarry has a gray tone, but tan colored (weathered) stone can be furnished on demand. About 75 men were employed in 1927.

Byberry. About 2 miles south of Byberry on the ridge between Byberry and Poquessing creeks and 1 miles up Knights Road from Red Lion Inn at Andalusia is a quarry worked by Anthony Mignone & Sons. The rock is blue Wissahickon gneiss with thin aplite veins parallel to the vertical sheeting, and pink gneiss with hornblende crystals up to 2 inches across. The quarry is a pit about 100 feet long with vertical walls nearly 75 feet deep. The floor is practically without

joints and blocks up to 1 cubic yard are raised. All rock is hoisted to the surface by steam derrick and there broken to one-man size. It is used both as rubble for foundations and ashlar for facing. Four men were employed in July, 1927.

Other quarries. Granite gneiss was formerly quarried at the Falls of Schuylkill on the west bank of the river, southeast of the station at Overbrook, on Indian Creek between Overbrook and Upper Darby. Hornblende gneiss was quarried at Frankford for foundations and dwellings and at McKinney's quarry near Queen Lane for paving block, bridges and schools.

Old buildings. Many of the early buildings in Philadelphia were along the bank of the Delaware and as that land is underlain with clay it naturally follows that brick was the common building material. Along the Schuylkill from Fairmount Park north and west, however, ledges of gneiss and schist made stone available to the early settlers thereabouts and many if not most of the substantial structures erected before the Revolution are stone. To be sure a two-story prison built about 1723 at High and Third Streets was of hewn stone and the foundation of the State House laid in 1729 was stone work, but these buildings, long ago demolished, are of little interest compared with eighteenth century buildings that are still standing.

On the east side of Schuylkill River north of the Girard Avenue bridge in Fairmount Park is one of these early stone houses. Mount Pleasant, built by Captain John MacPherson in 1761 is of gneiss quarried along the river bank. It has a base of coursed ashlar and large stone steps at the front door. The thick stone walls, however, are faced with roughcast and the quoins are brick.

Bartram House on the Schuylkill in Kingsessing was built by John Bartram in 1731 and enlarged in 1770; and Whitby Hall, also in Kingsessing at what is now 58th Street and Florence Avenue was built by Col. James Coulter in 1754. It was built of the native gray gneiss with large stones in the lower part grading to smaller ones in the upper part of the walls. (Whitby Hall has been torn down.)

Wynnstay, at 52d Street and Woodbine Avenue in the 34th ward, is a half century older, one part having been built in 1689 and the higher wing in 1700. The masonry is rubble, except for a circular window in the gable surrounded by dressed quoins.

Among the old stone houses in Germantown are Grumblethorpe, 5261 Germantown Road, built by John Wister in 1747; Johnson House, 6306 Germantown Road built in 1768 and now owned by the Woman's Club. Spalling is noticeable in the foundation and chips have broken from built by Hans Millan about 1690. The last is thought to be the oldest house in Germantown.

Also on Germantown Road are Cliveden and Upsala, Colonial estates opposite each other. Cliveden, built by Chief Justice Chew in 1761, is between Johnson Street and Cliveden Avenue. It is $2\frac{1}{2}$ stories of heavy masonry, the stone being a coarse-grained phase of the local gneiss laid as coursed ashlar. Select dark stone, dressed smooth, was used for corner quoins, and light-colored stone for window quoins. Spalling is noticeable in the foundation and chips have broken from the front steps which are blocks of gneiss 10 feet long.

Opposite the Chew house is the residence of Dr. W. N. Johnson, 6430

Germantown Road, known as Upsala. It was built by John Johnson in 1798, using the same local gneiss as in the Chew house. The difference in appearance is explained by the smoother faces of the ashlar in the Upsala house. The front elevation is dressed ashlar well pointed, but the end walls are small rubble. The front steps and window quoins are white marble.

Other buildings in Philadelphia for which the stone was quarried from outcrops of gneiss along the bank of Schuylkill River, include: Penn Mansion, Letelia Court (foundation), 1682; Old Swede's Church (foundation), 1698; Christ Church (foundation), 1727; Old State House (foundation), 1732; Belmont Mansion, 1742; St. James of Kingsessing Church, 1762; Mennonite Church, 1770; Carpenters Hall (foundation), 1770; Woodlands Mansion, 1775; Eastern Penitentiary, 1823; Seminary of St. Vincent de Paul, 1876.

Modern buildings. A description of the many interesting features of the use of building stone in Philadelphia alone would make a volume. In Chestnut Hill and Germantown buildings of local mica schist and gneiss are particularly common, and in the newer and better class residential sections a great many houses have been built in the last 15 years of the gneisses and schists from quarries in Philadelphia and Delaware counties. This stone is so durable and acceptable in every way that no further comment is called for. In the older parts of the city one sees an occasional home or store of serpentine from Chester County. This stone is no longer quarried or used because it deteriorates notably in the city atmosphere. It turns from green to a sickly or jaundiced yellowish-green, and the surface spalls off, in some cases to a depth of two inches. Several buildings at the University of

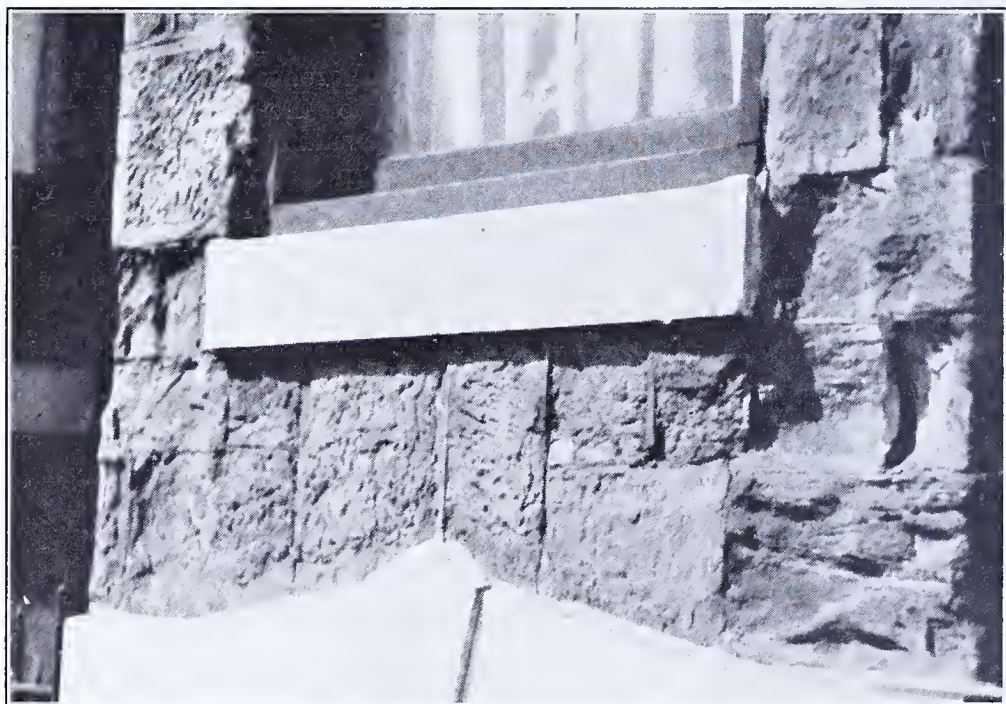


Fig. 138. Comparative weathering of Pennsylvania white marble and serpentine in a house at 21st and Race Streets, Philadelphia. Deep spalling of serpentine is common in many houses in this city.

Pennsylvania are faced with this stone, and the Memorial Baptist Church, North Broad and Master Sts. The church shows deep spalling of the serpentine, and where flakes have recently come off the bright green of the fresher rock is in strong contrast with the greenish yellow of the weathered surface.

In many blocks of houses built in the last third of the nineteenth century are white marble doorsteps and window sills. This use is a conspicuous feature of some parts of the city. In spite of daily or weekly scrubblings for several decades most of this marble still exhibits its original whiteness and shows little or no sign of wear.



Fig. 139. Common use of Pennsylvania white marble for trim in row of brick houses in Philadelphia, 50 years ago.

A coarser-grained marble from the Thomas farm $3\frac{1}{2}$ miles east of Downingtown, Chester County was used in Founders Building, at Girard College, built in 1832. The marble in the great fluted columns shows deterioration, and in places has had to be patched. Similar marble, perhaps from the same source, in the old Customs House at Fifth and Chestnut Streets, and in the old Girard Trust Company Bank on Third Street at Stock Exchange Place, is in worse condition. Had these buildings been in a less polluted atmosphere the marble might have endured longer. The newer buildings at Girard College are Vermont and Georgia marble, and the high wall surrounding the forty acre tract is the local mica schist.

The Baptist Temple (1885) and Temple College (1893) in the 1800 block on North Broad Street look like Pennsylvania marble. Conway Hall (1922), Temple University, North Broad and Montgomery Streets is greenish mica schist from Chestnut Hill, trimmed with terra cotta that has chipped. The unit of this structure built in 1928 and

trimmed with Indiana limestone is a fine looking job. This stone came from the Chestnut Hill Gray Stone Company quarry at Germantown Road and Mermaid Lane.

Triassic brownstone has been used extensively. A notable example is the Cathedral of S. S. Peter and Paul on Logan Circle. I did not learn from what quarry the stone came, but the fact that some of the stone failed notably by spalling and breaking is made apparent by patching with off-color plaster. Brownstone fronts are common on North Broad Street in the 2400 and 2500 blocks. Some of the stone is deeply spalled, especially in the lower courses.

The character of a Pennsylvania monumental stone, the Triassic diabase or trap rock is illustrated at Logan Circle by the Shakespeare monument in front of the Free Library. The highly polished black pedestal of this monument was quarried in and finished at Coopersburg on the Bucks-Lehigh county line.

PIKE COUNTY.

Pike County on the Delaware has 544 square miles and only 7,500 inhabitants or 14 to the square mile. Only two counties, Cameron and Forest, have fewer people per square mile. Most of the settlement is along the Lackawaxen and Delaware rivers. The rest of the county is a wooded plateau, covered with glacial drift, and spotted with many ponds, a wilderness in which hunting and fishing camps are more numerous than permanent homes. Devonian rocks including sandstones and shales of Marcellus, Hamilton, Genesee, and Chemung age outcrop in the bluff along Delaware River; Catskill sandstone is the surface rock in all the rest of the county except for small areas in the southwest corner (Greene Township) that are underlain by Pocono sandstone.

Sandstone has been quarried at several places in the county, mostly for flagging and curbing. The stone is called bluestone because of a slightly bluish color of the fine-grained hard sandstone that occurs in thin beds with smooth bedding planes. Most if not all of the quarries are in beds of Catskill age. Practically all quarries are along the Lackawaxen and Delaware rivers because of accessibility to a railroad. Stairway, Pond Eddy, and Shohola have shipped bluestone for many years. The largest flagstone shipped from this vicinity measured 15 by 25 feet and was 8 inches thick. It was raised for the sidewalk in front of W. H. Vanderbilt's residence on Fifth Avenue, New York City. This stone was quarried on the New York side of the Delaware below Shohola because of convenience to the D. & H. canal on which the stone was transported. Equally large flags could be taken at Shohola.

The Catskill formation is over 3,000 feet thick in Pike County and made up of sandstone and shale. The sandstone beds may be 25 to 50 feet thick or several hundred feet thick and separated from other sandstone members by a few or many feet of red shale. The Delaware River flags, which are the site of the large quarries, are over 1,400 feet thick and consist mostly of grayish-green sandstone interbedded with shaly beds. The hard sandstone beds outcrop in the river bluffs in massive looking ledges, but when quarried these ledges split into layers a few inches thick.

The Chemung rocks are a thick series of bluish-gray and olive sandstones and dark shales and slates that make the bluff several hundred feet high bordering the Delaware.

Dingmans Ferry. Bluestone quarries have been operated on the hill four miles west of the village by Squire V. Hood since 1898. They are small openings along the outcrop of a rather thin-bedded sandstone near the top of the ridge. Operation has been only occasional to supply the local need for flagging, coping, curbing, and grave vaults, and has been by hand labor. The beds pitch slightly into the hill, and when the cover becomes too heavy, or water interferes, that opening is abandoned and another started. Some of the stone will not split readily into flags but might be used for building stone if there were a demand for it. This stone is fine-grained and should be very durable.

Milford. As there is no railroad or canal along Delaware River in Pike County below Port Jervis, and stone buildings are found in the villages, one must conclude that the stone is of local origin. The sandstones of the Catskill formation outcrop in the hills 2 to 5 miles back from the river and have been quarried in several places for flagging, curbing, sills, and lintels. Less commonly this stone has been taken for the entire walls of buildings. The stone is medium-grained, gray, feldspathic sandstone and is well adapted to use in buildings. It splits clean on the bedding planes and as quarry-faced ashlar is particularly pleasing.

Several houses and a school house in Milford are built of this stone taken from small quarries on Dwork Kill at the mouth of Raymonds Kill, 5 miles west of Milford. Much of this stone was quarried by Charles J. Barlow. These quarries also have produced flagstone, well curbs, and hearth stone but have been idle for many years.

Grey Towers, the home of Governor Gifford Pinchot at Milford, is built of sandstone from old stone fences.

Milrift. Along the Delaware above Port Jervis are several bluestone quarries operated for flagging and curbing. At Milrift, the summer colonists have used local bluestone in bungalows and glacial cobbles in a dam and bridge over a small run. Delacey Hazleton told me that he has quarried bluestone on Bush Kill about $2\frac{1}{4}$ miles west of Milrift. The quarry, which is directly on the road, has a face about 200 feet long and is very deep, but is now full of water. According to Hazelton there is three years supply of stone on the quarry floor ready to work out, but it lies under 35 feet of water. The product of this quarry was flagging, curbing, and big blocks (called headers) for bridges, mostly shipped to New York.

Pond Eddy. A. H. Woodward & Co. is producing flagstone and curbstone from quarries a quarter of a mile up Pond Eddy Creek and 200 feet above the stream. These quarries have been producing for many years under the direction of Claude Maxwell. In 1931 curbstone was being shipped to Paterson and other cities in northern New Jersey, and flags were cut to pattern for floors and paved terraces.

Lackawaxen. The person interested in building stone notices first at Lackawaxen the Erie Railroad station. It is built of random, quarry-faced ashlar said to have come from the Kilgore or other near by quarry. The Catskill sandstone is quarried at a number of places along the Delaware between Lackawaxen and Port Jervis, mostly for flagstone and curbstone, but building stone also can be supplied. This sandstone is commonly known as bluestone because of its slightly bluish color. A quarry was being operated on the point between Delaware River and Lackawaxen Creek 160 feet higher than the rail-



Fig. 140. Catskill sandstone from local quarry in railroad station, Lackawaxen, Pike County.



Fig. 141. Catskill sandstone in canal aqueduct, Lackawaxen, Pike County. Note that chisel marks for water gauge are conspicuous after 90 years.

road in 1922. The stone lies flat, has only about 5 feet of cover, and lifts in beds 3 to 5 inches thick. An example of the flagstone that can be produced in this vicinity is seen in the grounds of the Delaware Hotel, a Hebrew summer resort at Lackawaxen, where there are stone 5 by 12 feet, 7 by 11 feet and smaller sizes, all 4 inches thick. Stone of this character that will stand the abrasion of many feet for many years will of course make a very durable building stone.

The abutment and piers of the abandoned canal aqueduct over Lackawaxen Creek just above its mouth are built of dressed stone that are reported to have been quarried from the sandstone exposed along a small run at Lackawaxen. Although the bridge was built in 1840 or earlier the Arabic numerals cut in the stones to indicate the depth of water are perfectly clear to this day. Of course they may have been recut or freshened but the writer has no knowledge of this. The canal was abandoned in 1899. The bridge over Delaware River at Lackawaxen built originally to carry the canal over the river also rested on piers of native sandstone from the bluff just south of Lackawaxen. This grayish-green sandstone was used also in the railroad bridge across Lackawaxen Creek just above its mouth.

Kimbles. Where the highway crosses Lackawaxen Creek at Kimbles is a dry stone wall which supports the narrow road along the creek bank. Presumably this stone was derived from blasting the ledge to make room for the road. The undisturbed ledge on the opposite bank shows the character of this sandstone when long exposed. Quarries at Kimbles, however, are up in the hills. The Woodward quarry $2\frac{1}{2}$ miles south of the village is near the top of a ridge and 450 feet higher than the railroad at Kimbles. When I saw it in 1922 the quarry face was about 350 feet long and 25 to 30 feet high in bluestone with nearly horizontal bedding. Some parts of the ledge are shaly or so irregularly bedded to be valueless. Most of the output then was curbing, shipped to New York and other eastern points. Flagstone also was produced and building stone might have been because on quarrying into the hill the stone "freezes" into thicker beds. Compressed air drills were in use and a horse whim operated the derricks. The rock was hauled down the mountain by team to Kimbles for shipment. A smaller quarry on a hill overlooking the village was idle but that it could produce building stone was evidenced by block measuring 8 feet by 30 by 15 inches. There was a large stock of flagstone on the dock at Kimbles in 1931, but little, if any, was shipped that year.

Shohola. The great cliff along the Delaware for several miles is composed of Catskill beds, conspicuous among which is gray, heavy-bedded conglomerate full of quartz pebbles. Most of the beds are greenish-gray sandstone and shale, hundreds of feet thick. The rocks are well exposed in the glen at the mouth of Shohola Creek where the rock cliffs are only 40 feet apart but the perpendicular west cliff rises 200 feet above the stream. Stone for the railroad bridge across Shohola Creek was quarried here, and those for the piers for the suspension bridge across the Delaware at Shohola were taken near by.

Bluestone has not been quarried at Shohola since about 1928 but several large quarries in the vicinity, especially those 1 mile up Shohola Creek can produce flagging and curbing when business demands.

Wallenpaupack Creek. The silk mill on the brink of a gorge south of Hawley is of greenish sandstone quarried in the east bank of Wallenpaupack Creek $\frac{1}{4}$ mile above the first cascade. The rock splits naturally in beds 4 to 8 inches thick, and makes good, durable building blocks. The mill was built over 50 years ago.

On the headwaters of the creek in Greene Township massive conglomerate and sandstone beds are exposed, particularly in High Knob where a conglomerate makes a cliff 60 to 75 feet high that is so precipitous as to make access to the top of the knob difficult except at one place. Stone suitable for building is available in all the other townships, except where deeply buried in drift, but only along the river is there any settlement.

POTTER COUNTY.

Potter County in the middle of the north tier is one of the very largest and one of the least inhabited counties in the State. With an area of 1,071 square miles it has only 17,500 people or only about 16 per square mile. The southern half is a forested wilderness on a plateau with deep narrow valleys. On one highway in this area there is a stretch of 14 miles without a building.

The geologic section in Potter County extends from the Chemung beds of the Devonian up through the Pocono, Mauch Chunk, and Pottsville into the base of the Coal Measures. Because of the structural folds that cross the country in a northeast direction these rocks outcrop in bands. The largest area of Chemung rocks is in the northwest corner of the county, with a broad band of Pocono just south of it extending from Pleasant Valley to Genesee Township. The Pottsville occurs mostly on the upland in two bands of more or less detached, irregular bodies, each surrounded by a narrow belt of red Mauch Chunk shales, which in many places is so thin as not to be observed.

The following notes are from Sherwood:¹ Thick-bedded red sandstone suitable for building purposes occurs in the Catskill beds on Kettel Creek, $\frac{3}{4}$ mile above the mouth of Cross Fork in Stewardson Township. In West Branch Township the Pocono is largely a thin-bedded gray sandstone interleaved with red shale, and the Pottsville is a hard white quartzose conglomerate 30 to 40 feet thick.

In Eulalia Township a quarry in the Pocono beds at the lower end of Coudersport yielded some very good building stone and large blocks of conglomerate rolled down from the top of the hill are numerous at the mouth of Dingmans Run. In some of the northern townships rock exposures are rare. The higher levels are underlain with white pebbly sandstone of the Pottsville (?) series. At Hebron and down Fishing Creek into Clara and Roulette townships coarse conglomerate boulders, probably Olean conglomerate, are strewn abundantly; also one mile east of Oswayo. Northeast of Sharon Center $\frac{3}{4}$ mile and between Sharon Center and East Sharon fields are strewn with large detached masses of white conglomeratic sandstone, possibly of Chemung age.

In the northeast corner of the county a light gray grit with minute brown specks is exposed in the banks of Cowanesque Creek below

¹ Sherwood, Andrew, *Geology of Potter County: Pennsylvania Second Geological Survey, Rept. GGG, 1880.*

Harrison Valley. It would dress nicely and make excellent building stone.

The foregoing notes from Sherwood's report indicate the presence throughout the county of massive sandstone of one formation or another, ranging in color from white through grayish-green to red, and from fine-grained to pebble conglomerate. All of these will furnish rough building material and some are suitable for making dressed stone.

My own observations do not cover the whole county. My impression is that practically the only masonry of dressed stones in the south half of the county is in railroad bridges and culverts. This area south of the Roosevelt Highway is a forested wilderness, as much the home of deer and bear as a hundred years ago. The pike from Sweden Valley southeast through Cherry Springs and Oleona may still be described in the words of H. D. Rogers: "For 68 miles of this road, at the time of our last visit in 1846, the traveler passed the doors of only six houses." In such an area no use has been made of the abundant gray sandstone except for rough foundations and fences.

At Coudersport greenish-gray sandstone of the Pocono is exposed at river level and in 1928 at the building of the Coudersport Consistory about 20 feet of beds were uncovered in making place for an addition to the building. The stone looks massive but splits into thin layers. It would make building blocks a foot thick, and being an even-grained stone should dress well. These beds are exposed also near the bridge at the west end of town.

Higher beds in the Pocono series were quarried many years ago on the road leading northwest from the north end of the village, and



Fig. 142. Pocono (?) sandstone in jail wall at Coudersport, Potter County.

about 300 feet above it. About 100 feet higher on the ridge between Coudersport and Hebron is massive gray sandstone with pebble layers.

The most notable stone building in Coudersport is the jail. It is a square structure with recreation yards on two sides enclosed by high walls, all done in gray, coarse-grained sandstone. In sunlight it has a greenish hue. The blocks range up to 3 feet long and are mostly about 1 foot thick, all squared and dressed to rock face except around the main entrance, where smooth-faced blocks were used. The stone is said to have been derived from float blocks on the near by mountain side.

The building of the Coudersport Consistory is of brick, with a foundation of pinkish and light buff sandstone laid as rock-face ashlar. This also is said to be local stone broken from loose float. Although built in 1913 the wall has not yet acquired the somber hue that may be expected of it eventually. House foundations throughout the village are mostly of massive, gray sandstone, probably from the Pocono beds that surround the town.

The Catholic Church and National Hotel at Coudersport are built of reddish sandstone thought to be from Galeton near the east border of the county on Pine Creek where Catskill beds are exposed. Some blocks are all red, some gray, and some mixed, but the effect of the whole is red. The stone in all of these buildings shows no readily apparent defects and appears to be perfectly durable. The Citizens Safe Deposit & Trust Company building is of fine-grained, greenish-gray fossiliferous sandstone from Warsaw, New York.

SCHUYLKILL COUNTY.

Although Schuylkill County is ribbed with a variety and abundance of sedimentary rocks, the native stone buildings within its boundaries are few. This county in the mountains of the anthracite region, and centering around Pottsville, contains sandstone ranging in age from Medina to Coal Measures. The Medina sandstone makes Kittatinny Mountain which forms the southern boundary of the county. In the valley at the foot of the north slope of Kittatinny Mountain the Helderberg limestone and Oriskany sandstone outcrop in a narrow band along the south side of Lizard Creek, past New Ringgold and Orwigsburg to Schuylkill Haven. Here they turn back and make a line of hills east of Pine Creek and south of Bear Creek, following a direct course to Swatara Gap.

Pocono sandstone makes Second Mountain which follows a nearly direct course across the county, and outcrops in Mahantango and Line mountains west of Taylorville. Pottsville conglomerate, the formation characterized by a great abundance of white quartz pebbles, is widely distributed. It forms Sharp Mountain that makes the river gap at Pottsville, and Pisgah Mountain east of Tamaqua and has a northern pitch. In the parallel ridge, Locust and Nesquehoning mountains, it pitches south. North of Pottsville this conglomerate is exposed in large areas on Broad and Green mountains.

These rocks already mentioned, and the sandstones in other formations, including the Coal Measures, are the sources of native building stone.

In Pottsville one may see many interesting exhibits of building stone; a few of the notable ones are listed with date of erection.

Court House (1889), Cleveland, Ohio, sandstone.

Henry Clay monument, base (1852) Pottsville conglomerate.

Column and figure are cast iron.

First Methodist Episcopal Church (1903), granite.

Second Presbyterian Church, serpentine.

Residence Dr. Wm. F. Doyle (1920), West Grove marble.

Public Library (1921), brick, with Indiana limestone trim and granite base course.



Fig. 143. White marble from King of Prussia, Montgomery County, in Trinity Lutheran Church (1911), Pottsville.

Schuylkill Trust Company, pink granite and Indiana limestone.

Miners National Bank, white marble.

Trinity Lutheran Church (1911), white marble from King of Prussia.

First Presbyterian Church (1874), Pottsville sandstone, trimmed with brownstone. Addition (1926) same stone, said to be from old canal locks.

St. Patricks Roman Catholic Church (1891), West Grove marble (or maybe King of Prussia).

German Catholic Church, Hummelstown brownstone front, Pottsville conglomerate side walls.

Kaercher residence, 820 W. Mahantongo St., serpentine (1905?).

Charles Beber cemetery gateway (1868) and chapel, Pottsville conglomerate.

Patterson public school (1909), Market and 12th Streets, Hummelstown brownstone base and trim.

Trinity Episcopal Church, S. Centre St., Pottsville conglomerate, also addition (1905).

Tydol gasoline station (1929), S. Centre St., Pottsville conglomerate from demolished building, redressed.

Union Bank and Trust Co., Indiana limestone.

Pennsylvania National Bank (1915), granite.

Safe Deposit Bank of Pottsville, granite.

Many curbstones in the city are Pottsville conglomerate. Some are 15 feet long.

Schuylkill County prison, old part, front and tower (1851) of brownstone with much conglomerate, source not learned; addition (1879) and enclosing wall are native Pottsville sandstone and conglomerate.

Of the Pottsville conglomerate it may be observed that the freshly quarried stone is variegated, including gray, light tan, and pink in warm but not lively tints. These colors make a pleasing effect, but in 25 to 50 years the colors either fade to an even tone of gray or the stone becomes soiled so that the colors are not noticeable. Much of this stone is used as rock-faced ashlar; in the First Presbyterian Church some is dressed fairly smooth. The front of this church is stained black and shows how unattractive this massive and durable stone may become in city atmosphere. It will be interesting to observe in how many years the colorful stone in the 1926 addition acquires the even gray tone of the main edifice.

The Charles Beber cemetery gateway (1868) is an example of excellent work with the local conglomerate. The stone is cut to blocks up to 18 by 48 inches and hand dressed to nearly smooth faces. Colors are buff, different shades of gray, and slightly reddish; but now weathered to an indefinite tone.

Serpentine seems not to be a satisfactory stone in the Pottsville atmosphere. The front of the Second Presbyterian Church has serpentine rubble in the main wall and dressed ashlar in the buttresses. The dressed stone is bright green and spalling, while the rubble is a horrid yellowish green. The house at 820 W. Mahantongo Street likewise is a miserable yellowish green except just above the sidewalk

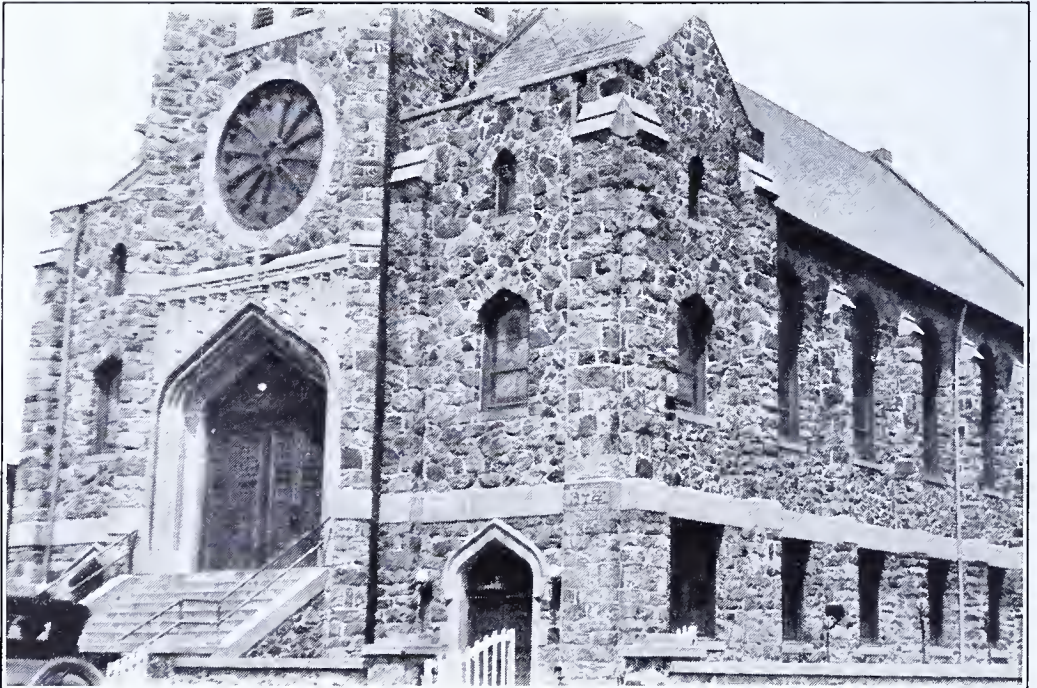


Fig. 144. St. Bartholomew R. C. Church (1922), Brockton, Schuylkill County, built of Pottsville conglomerate.

where the tool-dressed ashlar has spalled and the fresher rock is emerald green. It would seem that the Pottsville atmosphere tends to make the stone turn yellow.

At Brockton the men of the Roman Catholic parish, by working in their spare time, have built St. Bartholomew's Church (1922), a stone edifice 50 by 100 feet with an adjoining parochial residence. The Pottsville conglomerate was taken from float along the creek and was used as rubble in the main walls, with ashlar in the corners. Purple, red tan, and gray are the principal colors and lend a pleasing effect to the rough stone walls. How long it will show these colors remains to be seen.

Tamaqua. Calvary Episcopal church (1851) probably had the warm, interesting color of the Brockton Roman Catholic church but in 80 years has altered to a greenish buff. Some blocks show red, others light brown; much dark stain has accumulated. Pottsville conglomerate, of which this church is built, outcrops in the ridges on both sides of Tamaqua and is the most readily accessible building stone.

The Tamaqua National Bank is Indiana limestone. T. McGeehan's residence, corner of Broad and S. Elizabeth Streets is Mt. Airy, N.



Fig. 145. Zion Lutheran Church (1927), Tamaqua, Schuylkill County, built of granite from Seisholtzville.

C., granite, and his garage is mica schist from the Philadelphia district. Zion Lutheran Church (1927) is built of reddish granite from Seisholtzville, with water tables and steps of Mt. Airy (?) granite. The mottled Seisholtzville granite laid as massive coursed ashlar makes very attractive masonry.

In the southeastern part of the county, between Orwigsburg and Snyders, the rock used for building is either conglomerate or a hard gray and buff sandstone, with some black sandstone. The few stone buildings are mostly whitewashed.

In Tower City many walls are of Pottsville conglomerate, some of which is prettily colored. An abundance of conglomerate with many

quartz pebbles over half an inch in diameter is exposed on Keefer Summit, but from there through Tremont and Minersville to Pottsville there is no conspicuous masonry, most of the stonework being greenish Coal Measures sandstone.

North of Pottsville much conglomerate is exposed in road cuts between St. Clair and Frackville and on the heights to the north of Shenandoah. How well this conglomerate can be dressed is shown by the gate posts of a cemetery on Shenandoah Heights. The appearance of the rough and dressed stone are contrasted here in the massive walls surrounding cemeteries.

The coal-mining towns, as Frackville, Gilberton, Mahanoy Plane, and Girardsville are mostly frame construction, with an occasional brick building. One good stone job in Girardsville is the lower story of a church built in 1872 of local sandstone.

A two-arch stone bridge over Mahanoy Creek at Ashland is built of moderately large blocks of presumably local sandstone, as is also the foundation of W. C. Estler school. The front wall of the school is well dressed stone and the side walls are rather rough blocks, both sandstone and grit. This stone is durable but the wall does not look well because it is a mixture of gray, tan, brown-stained, and almost black stone.

Ashland presents some brownstone fronts, and some of its curbing is Pottsville conglomerate of local origin.

SNYDER COUNTY.

Along the west bank of the Susquehanna below Sunbury for 20 miles and extending west from the river about 30 miles is Snyder County. Selinsgrove, Port Trevorton, and Middleburg are the principal towns. Jacks Mountain forms part of the northern boundary and West Mahantango Creek some of the southern boundary.

Although this county is in the Vallemont region the structural folding of the rocks is not so close as in some areas and the Helderberg-Oriskany groups are repeated only four times in nearly 20 miles, as compared with six times in two miles at Lewistown. The Helderberg limestone outcrops at McKees Half Falls; in two bands from near Selinsgrove southwestward, one band going by Middleburg and Paxtonville to McClure; and along the northern side of the county southwest from Centreville. Shade Mountain and Jaeks Mountain are composed of Tuscarora and Oswego sandstones, and the Oriskany sandstone follows the Helderberg limestone. Large areas are underlain by the Devonian shale formations.

Although the Tuscarora sandstone, Helderberg limestone, and the hard, sandy members in the other formations are available from one end of the county to the other and suitable for the common rural uses of building stone, yet stone has been used but little except for rubble foundations of houses and barns.

Stone Buildings.

Selinsgrove. The Farmers National Bank is Indiana limestone and the First National Bank (1925) is cast stone imitation of Indiana limestone on an imitation granite base. Hendricks Hardware Company has verde antique under the windows that looks like the stone from Cardiff, Maryland. Some buildings on the main street are trimmed with Hummelstown brownstone. A house built by John Snyder

at the corner of Eighth and Mill Streets is of Pottsville conglomerate said to have been obtained from a building that was torn down in Ashland. The foundation is local sandstone.

Mr. Snyder also built a double house near the corner of Spruce and Orange Streets, using Tuscarora sandstone from the south side of Shade Mountain near Fremont, 14 miles west of Selinsgrove. This masonry, built since the World War, is a mixture of light tan, gray, pink, yellow, and red, in 4-to 8-inch random ashlar, and makes a pleasing appearance.

Freeburg. About 1 mile east of Freeburg is a limestone farm house, the front of which is rather smooth coursed ashlar of an even gray color and good appearance. In Freeburg there is only one stone building, a house built of pitted Tuscarora quartzite and a lesser quantity of gray limestone. This mixture of different kinds of stone does not look well.

Port Trevorton. Three-quarters of a mile south of Port Trevorton on the Susquehanna Trail is a two-story sandstone house owned by Dr. John R. Arnold of Washington, D. C. The front is coursed ashlar and the other walls are ashlar and rubble mixed. The tenant says the building is about 100 years old, that the stone was raised from ledges in mid-river, and that slabs 10 to 12 feet long could be taken there now. This stone has smooth joint faces and bedding planes that yield block 2 to 3 feet long and up to 6 or 7 inches thick. It weathers buff, greenish, and black. This stone may be from a formation equivalent to the Portage flags of Devonian age.

The next house on the south, built about the same time and used by Dell Brook for tourist lodging, and a third house still farther south but on the river side of the road apparently are the same fine-grained sandstone.

Middleburg. Foundations of yellowish sandstone and quartzite are common in this village, but stone buildings are few. The rubble for these rough walls is derived from float on the near by mountains.

The Snyder County prison was built in 1886 of sandstone dressed to rock-face ashlar and laid in massive courses. Two base courses just above the ground are bright red sandstone blocks 1 to 4 feet long; the main walls are gray to light buff sandstone, and the trim is red sandstone with white quartz pebbles. I was informed by a local merchant that the stone for the main walls came by rail from near Lewistown. This may mean that it is Oswego or Tuscarora sandstone from The Narrows where great rock floes were then close to the railroad. The red trim over the windows is said to be Hummelstown brownstone.

The wall around the prison yard is pitted yellowish quartzite said to be from Shade Mountain, which is 3 miles south of the village and made of the Oswego and Tuscarora sandstone formations.

The Snyder County Soldiers' Memorial building is yellow brick with Indiana limestone columns and granite base, and the first floor of the Court House and the porch on Dr. Hermann's house are brownstone, probably from Hummelstown.

SOMERSET COUNTY.

This county, named for a county in England, is on the southern tier between Bedford and Fayette counties. It is one of the ten

counties having more than 1,000 square miles, and contains the highest land in the State, Negro Mountain, 3,220 feet above sea level. Somerset County contains within its borders the Catskill red sandstone, Pocono sandstone, Pottsville conglomerate, Loyallhanna limestone, and the sandstones and limestones of the Coal Measures up to the Pittsburgh coal. The Pocono and older formations are only in the southeast part of the county, along the crest and east of Allegheny Mountain. The Pottsville conglomerate occurs along the crest of Allegheny Mountain, on Negro Mountain, and Laurel Hill.

I have notes on only a small part of this large county but they indicate that material suitable for building purposes is wide spread. Some of the sandstones in these formations are massive enough to yield sizeable blocks and are durable, though they may weather to an unattractive color. The limestones are hard to work and break with irregular fracture, but can be used where accessibility is a deciding factor.

Most of the building stone produced in this county is gotten out by farmers for their own use or on demand when a mason has an order for stone construction. In 1928 Mr. George W. Miller of Somerset was thus employed and may have been the only man quarrying stone in the county that summer. His work consists of breaking up large blocks of sandstone scattered through the woods and fields of his farm 3 miles east of Somerset on the Berlin or plank road. By hand drilling, he splits the rock to one-man size, and many blocks need little trimming before going into a wall.

The "mountain stone," as it is called around Somerset, probably is Pottsville in age. In natural exposure it has a light gray color, due probably to leaching of all but silica. On fresh fracture it shows gray, tan, pink, brown, and streaked. Where exposed in a building in town the stone may in a few years become brown but in these towns where soft coal is the common fuel most masonry soon becomes blackened with coal soot.

At Somerset, the county seat, the Court House, First National Bank, and Somerset Trust Company bank are faced with Indiana limestone. The banks have polished granite bases. Several churches and other buildings, however, are of local stone.

The Methodist Episcopal church (1926) is light tan sandstone from the Frank Metzler farm. The fresh stone is a pleasing color; it is laid in rough-face random ashlar; most blocks are squared but some are wedged-shaped or irregular. Thin gray mortar joints make the irregularity less conspicuous. A house next door is of rough, gray field stone, untrimmed, and laid with black mortar. The contrast between these two jobs is striking.

The Church of the Brethren (1921) is of mountain stone hauled in by farmers from their fields and cut on the job by Italian masons. The stone is laid in regular courses of equal thickness, with neatly pointed joints and is a fine job of this style of masonry. The base courses are 8 to 9 inches thick, the water table and lintels are 10 inches thick and up to 12 feet long, and the courses above the water table are 5 inches.

The Episcopal church also is sandstone from the Frank Metzler farm. The base of the brick high school is from the Koontz farm. The foundation of the Evangelical church and part of the Christian

church are from Frank Miller's farm, and stone has been taken from the Baker farm just beyond the country club on the Berlin Road.

Two buildings in Somerset, the home of ex-sheriff Griffith and a gasoline station on the north edge of town, are particularly interesting because they show pleasing results produced with worthless field stone. Thin-bedded sandstone weathered from the ledge and strewn over hillside fields was used with as little trimming as possible, leaving rounded, weathered edges exposed. Most of this stone is not over two inches thick. The 2-inch slabs were used near the ground and the 1-inch ones in the upper walls and arches. Laid with black mortar and deeply raked joints, the effect is worth noting.



Fig. 146. Gasoline station at Somerset.

Stoyestown has one sandstone building, the Elite Hotel. It was built probably from local stone, may be the Mahoning sandstone, which has weathered to a light brown. Two new houses east of Stoyestown and some stone walls of light tan, squared blocks also are of local sandstone. At Grandview on the Lincoln Highway, an observation point just below the crest of the Allegheny Mountain, the road has been widened by cutting back a sandstone ledge. In the 110-foot rock face the upper part is shaly and the lower part a massive, hard, blue sandstone which might yield durable building stone. It weathers however, to greenish and brown hues. This probably is the Pocomo sandstone.

At Somerfield where the National Highway crosses Youghiogheny River is a 3-arch sandstone bridge which was completed in 1818. Many of the blocks in the arches measure 12 to 20 inches and all are dressed with a smooth face. Two turrets on each side of the bridge are built of blocks cut with curved faces. The stone in this bridge appears to be sound in every respect. It is a gray sandstone, probably raised close at hand, for the Freeport sandstone makes a cliff

along the river and the Mahoning sandstone above it covers the slope with large blocks which would be a natural source of building stone at this place.

In areas where the Pottsville conglomerate is exposed, as on Allegheny and Negro mountains, the surface is strewn with large blocks. These vary in composition from coarse conglomerate of white quartz pebbles to fine sandstone, and are a ready source of much building stone. As yet however, stone has been used but little for building, except in rough foundations and in some places for fences. Bare Rock quarry in the Pottsville conglomerate about 4 miles southeast of Somerset has been worked within the last few years but I have not seen it. The location is on Laurel Run 2 miles east of Murdoek, a station on the B. & O. R. R. It is a large quarry served by a branch railroad.

Limestone is quarried in several places in the county and burned for lime and soil sweetener but I do not know of its being used for building stone. Some of the beds are thick enough to make building blocks but they are hard to dress to regular shape, go to pieces on exposure, or if siliceous are hard on tools.

SULLIVAN COUNTY.

The county that was named for Major General John Sullivan, an officer in the Revolutionary army, is best known perhaps as the location of the Bernice coal field and of Eagles Mere, a popular summer resort. The county is a deeply dissected upland, with considerable areas over 2,200 feet above sea level and culminating in points over 2,500 feet. Eagles Mere is 2,000 feet above the sea. Loyalsock and Muncy creeks are deeply entrenched in the plateau, flowing between hills that rise abruptly 800 to 1,000 feet on both sides.

About half of the county, most of the higher land, is underlain by Pocono sandstone. The valley of Muncy Creek is in Catskill beds, as is also the valley of Loyalsock and Elk creeks in a broad belt along the northern side of the county. Catskill beds make the walls of the narrow defile of Loyalsock Creek below Forksville. Devonian flags and shale of Chemung and Portage age occur mostly north and east of Campbellville, Mauch Chunk red beds encircle the Bernice basin, and Pottsville conglomerate underlies it.

From viewing a geologic map one may conclude that Pocono sandstone is widely distributed, Pottsville conglomerate is probably abundant in a small area, and that thin flaggy sandstones of Devonian age should be found along the main streams.

The county has been glaciated and boulders of foreign rocks are mixed with those of native origin.

On route 42, north of Laporte large blocks of white, sugary, Pocono sandstone are abundant. On fresh fracture this rock is pink. Should this stone be wanted for building, large quantities can be had in many parts of the county without quarrying.

Near Dushore red shaly Catskill sandstone is abundant and contains some hard beds that have been used locally for foundations. St. Basil's parochial school (1926) at Dushore is of yellowish sandstone and conglomerate quarried near Santterfield, 3 miles south of Dushore on the edge of the Bernice basin. The quarry is on the Lusch farm. I have not determined whether this is Pocono or Potts-

ville sandstone. The Roman Catholic Church at Dushore is of similar stone said to have come from Ringdale. If so, it must be the Pottsville conglomerate.

Pocono sandstone strews the surface around Eagles Mere and has been used in that village for rubble walls. Dressed to rock-face ashlar it has been used for foundations, porch pillars, and for a small church. The general effect of the freshly dressed stone is light tan. The buff sandstone in the Presbyterian Church probably is of Pocono age, for it came from an old barn, in which presumably the handiest stone was used. The Episcopal Church (St. John's in the Wilderness) is of field stone. All are sandstone and conglomerate but some are partly rounded and may have been brought from a distance by the continental glacier.

As Sullivan County is a forested area with a population of only 21 per square mile, it is easily understood that although the Pocono sandstone is widely distributed and easily obtained and other sandstones suitable for building are present, nevertheless the stone buildings are few.

Red flags have been raised near Muncy Valley and Sonestown from the Catskill formation but not in recent years.

SUSQUEHANNA COUNTY.

Susquehanna County is on the New York line and just west of Wayne County which makes the northeast corner of the State. It has no mineral industries save the occasional production of crushed stone, flagstone, sand and gravel, and is devoted largely to agriculture. It is covered by a close network of roads, has many small communities, and only a small amount of wilderness. The surface is covered and in some places deeply buried with glacial till, and is dotted with more than 75 ponds and small lakes.

Practically all of the county is underlain by beds of Catskill age. Upper members of the Chemung series come to the surface along Susquehanna River and its tributaries and in the northwest corner of the county. A very small area at Forest City in the southeast corner of the county is underlain by Pocono, Mauch Chunk and Pottsville beds, and North and South Knobs of the Elk Mountains in Herriek Township are made of Pocono sandstone and conglomerate.

Sandstone for building, flags, and curbs can be obtained throughout the county whenever there is demand. Few quarries have been opened as yet but every township has one or more prospective quarry sites. The Catskill series is 1,500 to 2,000 feet thick and composed of several distinct sandstone members separated by shales. Many of these sandstone members are 20 to 40 feet thick, lie nearly flat, and outcrop in cliffs in the sides of the valleys and around the hilltops. In outcrop these sandstones look massive and crossbedded, but when a quarry is opened it is common to find that the stone will lift in even layers 2 to 5 inches thick and make excellent flagstones. The sandstone commonly is greenish-gray and some of it is very hard.

In his report¹ on this area I. C. White divided the Catskill into several named members. He describes the Honesdale sandstone in three parts, white 25 feet, red 40 feet, and gray 25 feet. In this

¹ White, I. C., *Geology of Susquehanna County and Wayne County: Pennsylvania Second Geological Survey, Rept. G.5, 1881.*

county these are identified in Bridgewater Township and called the Montrose group.

The New Milford upper sandstone 20 feet thick is a massive looking, grayish, current-bedded stratum conspicuous in long lines of bold cliffs near the hill tops of northern and central Susquehanna Township. The New Milford lower sandstone 20 feet thick is boldly exposed 70 feet above the railroad at New Milford and its cliffy outcrop can easily be traced to Great Bend where it is 400 feet above the river.

These and other sandstones that outcrop abundantly in every part of the county constitute the building stone resources.

White referred to greenish-gray sandstone flags 2 to 4 inches thick being raised around Auburn, and on a small tributary of Susquehanna River below Red Roek. Also he states that piers of bridges along the Jefferson Branch Railroad were constructed of bluish-green, very hard sandstone quarried just below Stevens Point and about 400 feet above the creek. This is the Carbondale line of the Erie Railroad.

My own observations in the following paragraphs are based on visits to the county in 1922 and 1929.

At Stevens Point about one mile south of Brandt on the Erie Railroad in Harmony Township several quarries have been opened in the ridges on both sides of Starrucca Creek to get out flagstone and curbing for the market in southeastern New York and northern New Jersey. The quarries are in the Catskill beds and produce stone like that obtained along Delaware River below Laekawaxen in Pike County, and near Meshoppen in Wyoming County. The stone along the outcrop splits readily into flags of even thickness and smooth surface. All quarrying has been by hand methods; no quarry was operating near or shipping stone from Stevens Point in 1929. Along the railroad just west of the station is an old quarry with a face about 30 feet high, the lower 10 feet of which is massive sandstone that could be taken out in blocks suitable for building. This quarry, long idle and partly hidden by trees, furnished the stone for the Erie Railroad viaduct at Lanesboro. In 1931 several small operators quarried blue-stone near Stevens Point and about 6 earloads were shipped.

Diek Bailey has quarried flags and curbing on the ridge about $2\frac{1}{2}$ miles north of Stevens Point and Frank Baker has done the same in a small quarry between the two bridges at Brandt. Since 1927 Ed. McCloe has been shipping flags, curbs, and coping from Brandt. His stone dock on the railroad at times, carries a considerable stock of 3 to 4 inch coping up to 8 feet long, flags and curbs of various sizes, also landscape flags (irregular shape) in gray, blue, and red. The blue of course is only faintly bluish, like all the Pennsylvania blue-stone. McCloe's quarry is about one mile south and near the top of a steep hill. In 1929 it had a face about 140 feet exposing 20 feet of a massive ledge with little overburden. The stone raises in 2 to 6 inch lifts of any size. Air drills are used for breaking out from the ledge, and a steam crane with an 80-foot mast handles the blocks. Flags, curbs, and coping are worked out by hand and hauled to the railroad by truck. About 25 men are employed. Much of the product is marketed through J. G. Robinson, Germantown. McCloe quarries red sandstone occasionally near Starrucca.

Quarries on top of the ridge both sides of Lanesboro are worked



Fig. 147. Flagstone stock yard of Ed McCloe at Brandt, Susquehanna County. Quarry seen in mountain in background.

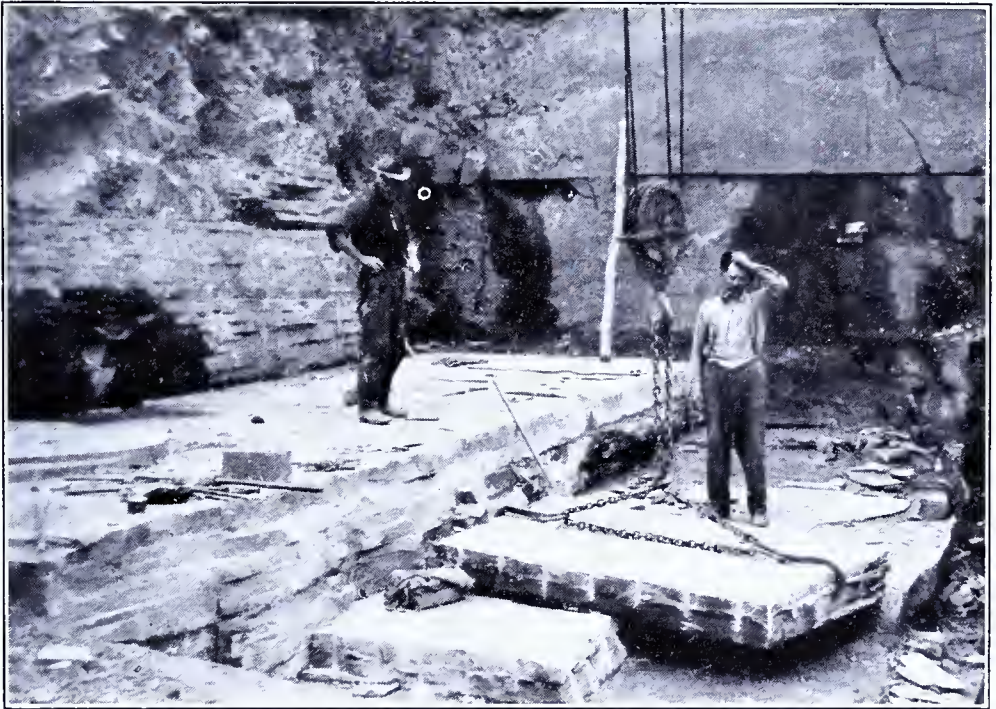


Fig. 148. Flagstone quarry of Walters & Call, Lanesboro, Susquehanna County.

intermittently. They ship curb and flagstone to Binghamton, Scranton, and Philadelphia. Their equipment includes a large crane for lifting blocks from the bed onto a wagon. Flags range from 2 to 6 inches thick. More massive beds, as that exposed in a hollow at the east end of town, would yield thicker blocks for building purposes.

This quarry may be in the top of the Chemung rocks or the base of the Catskill. The beds at creek level exposed in a face about 200 yards long are a 6-foot and a 20-foot ledge of bluestone separated by 6 feet of shale. The thicker ledge could yield large blocks suitable for heavy bridge masonry; blocks over 2 feet thick lie on the waste piles. No work has been done here in several years. If this is the quarry referred to in an old report as on Pig Pen Run, it was opened in 1874 and stone was shipped from it to New York, Philadelphia, Havre de Grace, Buffalo, and Chicago.

The high arch stone viaduct of the Erie Railroad at Lanesboro is built of bluestone which has weathered to greenish-gray and rusty color. The stone was quarried at Stevens Point and dressed to joint-face and rock-face random ashlar. The blocks are all sizes up to 6 feet by 10 inches, 3 feet by 20 inches, and some may be 24 inches thick. They are sound and the bridge looks as if it would stand for centuries. It was built in 1846-47 and is known as the Starrucca viaduct because it carries the railroad over Starrucca Creek. This great stone viaduct is one of the notable stone structures in the State, being 1,200 feet long, 98 feet high, and wide enough for double tracks. It has 17 arches and cost \$325,000.

Earl Hendrickson, hotel proprietor, at Lanesboro, has sold his quarry operations to Johnson and Rhoades Bluestone Co., Horton, N. Y., and is now their local manager. They have three quarries near Lanesboro producing flags, curbing, and stock and using power for cranes and drills. This company and Ed. McCloe buy the product of several small quarries in the neighborhood that are worked by one or two men. The market extends from northeastern Pennsylvania to New England. Hendrickson moves as much as 30 feet of cover to get 20 feet of workable bluestone.

In 1931 Ed McCloe had a large stock of flags on the railroad dock at Hallstead and during part of the summer shipped several cars a week. He was working a quarry on the Williams farm 3 miles west of Summerville. J. G. Robinson & Co. also has a stone dock at Hallstead.

I saw no notable stone work in Susquehanna or Hallstead except excellent flag sidewalks. Some building foundations are of the local greenish-gray, rusty, or red sandstone. In Montrose also flag walks are common and some are very fine. Store platforms are of large flags, 6 to 10 feet or larger. The foundation of the Court House is dressed greenish sandstone of local origin, and the county jail, built on and against an outcrop of sandstone, is of large and small slabs mixed. The local slabby dark gray sandstone was used also for a house at the southeast corner of the village park. The stone is durable enough but the color is not attractive for house walls.

On the James Dougherty farm between Montrose and South Montrose beside the road is an old sandstone quarry with a face 200 feet long and 25 feet high. Glacial till is lacking but 15 feet of worthless rock must be removed to uncover a workable flag bed. The stone lifts in heavy layers.

Four miles southwest of Montrose on the B. F. Jones farm, and one mile west of Cool Crossing, is a quarry that was worked at the time of my visit in 1922 by Wynans Brothers of South Montrose. This quarry was opened in 1906 by Lott Brothers of Springville and worked by them continuously for 13 years. Apparently the quarry

was started on a workable bed of flagstone on a hillside in the woods. As the work progressed into the hill the overburden of waste rock, partly red shale, increased to nearly 25 feet but the stone at that depth is very good and 14½ feet thick. Jointing is vertical and wide-spaced and bedding is inconspicuous. This facilitates getting out very nice flagstone and curbing and, of course, as the lifts are heavy, building stone can be produced on demand. The product of the quarry was going mostly to Scranton, Wilkes-Barre, and Pittston, but operations ceased some years ago.

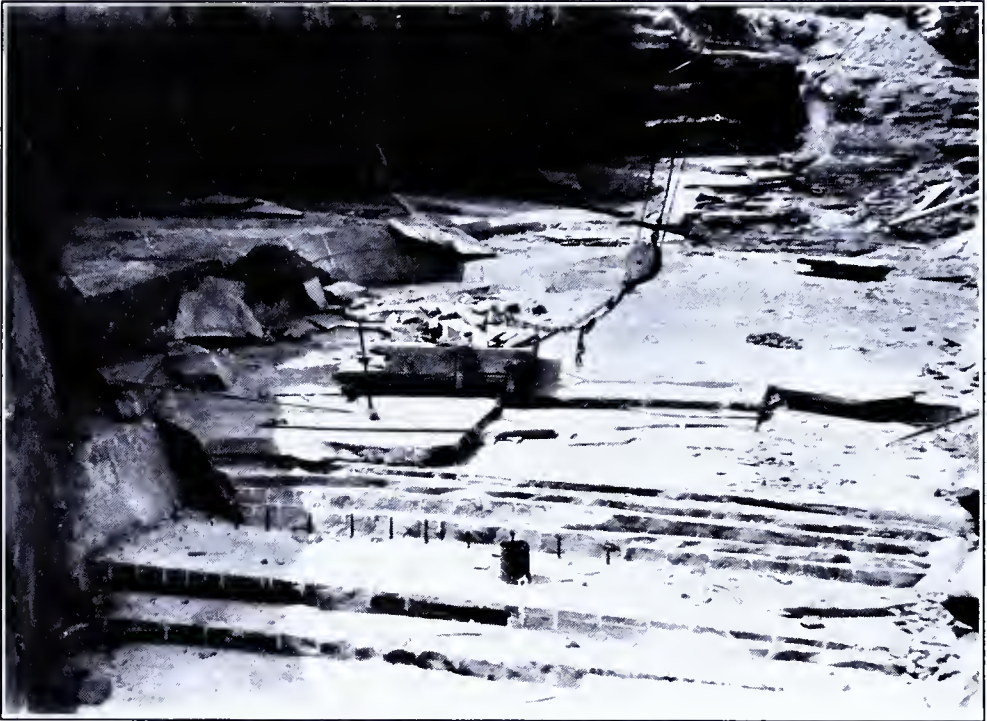


Fig. 149. Flagstone quarry operated by Ed. McCloe, near Brandt, Susquehanna County.

Since 1927 the long decadent flagstone industry has increased considerably and in 1929 several quarries in the central part of the county were being operated. J. M. Decker, storekeeper at Alford, was working 5 men in an old quarry 1½ miles west of the hamlet, getting out flags and "irregulars" for landscape work. Tom McCloe, Summerville, is operating 4 quarries in that vicinity, getting both light and heavy stock. He uses an air jack hammer in one and employs 9 men. Jack Tarbell also has a quarry 3 miles west of Summerville.

Kingsley is close to several flagstone quarries. James Crompton opened one in the spring of 1929, 200 yards up a ravine crossed by the Lackawanna Trail, and was getting out shingles, 2- to 8-inch flags in size up to 5 feet square, and curbing. On the hill 2 miles east of Kingsley, Stephen Millard and George C. Finn of Hopbottom opened a new quarry in June 1928. The product, all of which is sold to J. G. Robinson Stone Co., Germantown, is gray flags in sizes up to 4 feet square and mostly less than 2 inches thick. In May

1929 I saw Millard and his son raise a 3-inch flagstone measuring $20\frac{1}{2}$ by 4 feet, to be cut into 4-foot flags. Larger flags could be raised if desired.

Crompton and Hull were quarrying gray flags on the crest of the ridge within 100 yards of Millard and Finn in the summer of 1929 and selling to J. D. Emaek Co., Philadelphia. This also is a new operation, working surface beds with little or no overburden. Flags of any size up to 6 by 6 feet, or 5 by 7 feet are produced, and in thickness of $\frac{1}{2}$, $\frac{3}{4}$, 1, and $1\frac{1}{2}$ inches. The $\frac{1}{2}$ inch flags are used for shingles, and wall and floor tiles. Smith and Evans of Nicholson

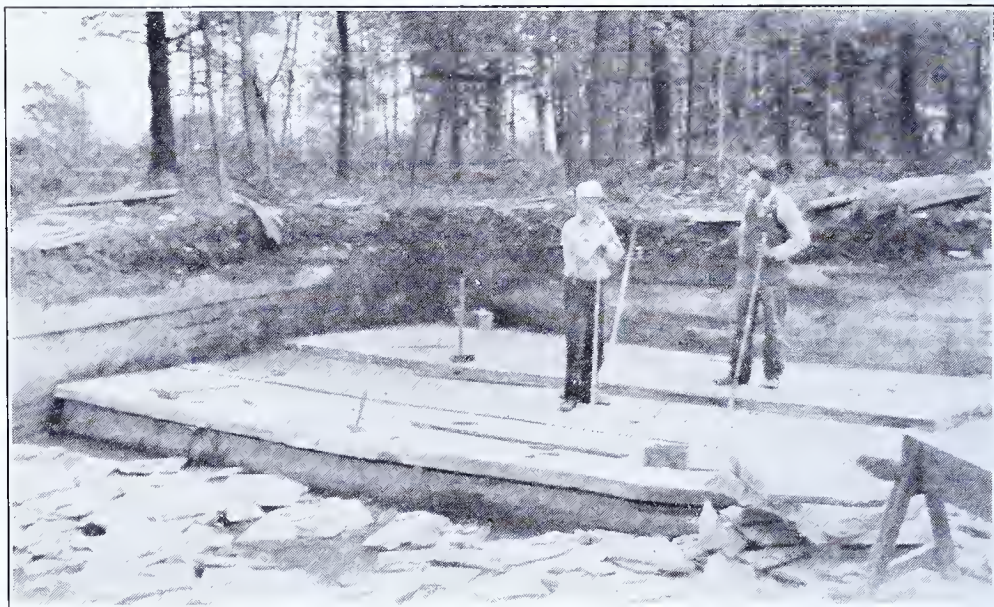


Fig. 150. Flagstone quarry operated by S. Millard, Kingsley, Susquehanna County. Note flag being raised measuring 20 by 4 feet by 3 inches.

were getting out gray flags on the Wm. Robb farm 4 miles southeast of Kingsley, in 1929. Their product is 1 to 2 inches thick, 1 to 3 feet wide, and up to 6 feet long. It goes to J. G. Robinson Company's yard at Nicholson. This quarry has been worked intermittently for 30 years and is above a curbstone quarry with a face 100 feet long and 10 to 15 feet high that has been idle 30 years.

At Hopbottom where flags are assembled at the railroad for shipment, the contrast between bluestone ashlar and rubble is illustrated by the stone platform at the station and the walls on the slope above it. Paul W. Bounds Co. of Philadelphia, established a stoneyard at Hopbottom in May, 1931, and in 6 months had accumulated a large stock of flagstone in a variety of sizes and colors.

The region between Hallstead and Nicholson probably has as many flagstone quarries as another prominent area that lies between Mesoppen and Towanda. The larger operators between Hallstead and Nicholson are J. D. Emaek Co., J. G. Robinson Co., Paul W. Bounds Co., Ed McCloe, and Tom McCloe. They produce flags of all sizes, and in a variety of shades or colors, including so-called blue, green, red, purple, lilac, gray, sage, and mottled. These colors, of course are not bright, but they have enough contrast so that patterns may be worked

out with them. These flags are used for interior and exterior flagging, garden walks and terraces, for coping, stair risers and treads, sills, wall panels, and very thin ones for roofing.

Auburn Center in the southwest corner of Susquehanna County has been a producer of bluestone for many years. Two quarries were operating in 1929. One is a large, old quarry $1\frac{1}{2}$ miles east of Auburn Center on the J. A. Degnan farm. Corey and Hay were getting out curbs, flags, and stock, using a Fordson tractor for power to operate the crane and to compress air for the jack hammer drill. The quarry face is long, irregular, and on a bed about 12 feet thick. The overburden, mostly red and green shale, varies in thickness in different parts of the quarry. About 25 feet seems to be the limit of profitable stripping, and where the overburden reaches that thickness, quarrying has stopped. The flags have a bluish tinge, weathering to rusty; range in thickness from $\frac{1}{2}$ inch to 2 inches, and some have a ripply surface.



Fig. 151. Flagstone quarry of Degnan & Winans, Auburn Center, Susquehanna County.

Two miles farther east is the quarry of Degnan & Winans, which was worked 30 odd years ago and again since 1925. It has a face 175 feet long on a bed of sandstone only 5 feet thick, but as there is no waste to this bed it is found profitable to strip 10 feet of shaly beds to reach it. In the west end of the quarry, joints are so close that only small flags can be made, few over 18 inches square, but at the east end flags 20 feet square could be raised. Four men were employed in June 1929, drilling by hand but with a gasoline engine to operate the derrick. The product is flags $\frac{1}{2}$ to $2\frac{1}{2}$ inches thick, but mostly $1\frac{1}{4}$ to 2 inches. The color of the flags ranges from light purple or lilac to gray-green. A great pile of waste consists largely of irregular flags about 1 inch thick that would be fine for garden walks and paved

terraces. The product of this quarry is sold to Ridgway & Son, Meshoppen.

Sandstone for building was quarried extensively near Forest City about the turn of the century. The principal location, known as the Williams & Watts quarry, was high on the ridge about a mile north of Forest City and west of the railroad. A road by which the stone was hauled to the railroad crosses the highway 300 yards north of a coal breaker. A conspicuous and resistant bed of coarse conglomerate crosses the ridge above the breaker. If this is Pottsville, then the quarry is in the upper part of the Pocono sandstone. It has not been worked for more than 20 years but examples of its use are worthy of attention. The only building in Forest City in which much ashlar was used is Christ Church, Episcopal (1891). Here the yellowish sandstone and fine conglomerate in random ashlar looks well and is very clean for having been exposed nearly 40 years. The front of the First National Bank at Forest City is said to be this native stone. In Carbondale, however, one may see this stone in the American Hotel (1893) and First M. E. Church (1892). Used in coursed and random rock-face ashlar, and weathering to an even tone of light gray, it presents a pleasing appearance that endures so long as the stone is fairly clean. In Hotel Jermyn (1895), Scranton, which is faced with this sandstone from Forest City, various degrees of atmospheric soiling are shown, for the top story is discolored much less than the street floor.

The possibility of carving this stone is shown in the scrolls and heads ornamenting the American Hotel, Carbondale.

There are other stone quarries in the county, some that are worked by farmers in slack time, some newly opened, some long abandoned. Most of them were opened for flagstones and rubble for foundations of houses and barns. Little use has been made of this abundant material for the main walls of buildings, probably because lumber has always been easily available and frame houses are much cheaper. Although much of this stone is in thin layers, that does not preclude its use for building and the dark gray to grayish green color to which it weathers should be no deterrent to farm use.

TIoga COUNTY.

Tioga County on the New York State line lies between Potter and Bradford counties. It contains some fine farming country and also extensive areas of forested wilderness underlain by Pocono sandstone. The geologic section extends from the Chemung to the Lower Productive Coal Measures, and each group is widely distributed; nevertheless Sherwood¹ in his description of the area mentions only three quarry sites. He says that blueish sandstone 2 miles from Mansfield up Corey Creek has furnished excellent building material, and that large quantities of flagstone are shipped from the celebrated quarries on top of a hill 1½ miles north of Mansfield. Evidently they have long been idle for residents of Mansfield did not mention them to me. Sherwood says flags were obtained of any desired size from 1 foot in breadth up to 20 or more, and as smooth and true as a plank, and being near the surface were quarried at slight expense.

Doubtless the Catskill and Pocono sandstones in their wide distri-

¹ Sherwood, Andrew, Report of Progress in Bradford and Tioga Counties: Pennsylvania Second Geological Survey, Report G, 1878.

bution throughout the county offer many opportunities for getting building stone suitable for local needs. They make cliffs and strew the surface with large blocks.

While crossing Tioga County in October, 1928, I failed to find much use made of stone for building purposes. In many instances it would seem that local field stone, thin-bedded sandstone from the Catskill and Chemung measures, has been used for foundations of houses and barns. The color commonly is greenish and some of the stone has very many molds of fossil shells.

At Mansfield I was told that bluestone in some good looking foundations and flag sidewalks came from a quarry at Mainesburg, about 5 miles east. The stone is bedded in layers about 5 inches thick and cut by rectangular joints; it trims easily in regular shape and makes a nice building stone. This large quarry is on top of a hill 1 mile north of Mainesburg on the Tom Hotchkiss farm. An abundance of clean gravel in Tioga River makes the use of concrete economical and popular at Mansfield. The base, water table, main entrance and trimming of State Teachers College are Hummelstown brownstone.

At Wellsboro the principal stone buildings are the County Court House (1835), St. Paul's Episcopal church (1897), and First Presbyterian church (1894). The first two are built of Pocono sandstone taken from blocks abundantly strewn the surface at the summit about 4 miles south of town on the road to Antrim. The Court House is smooth-dressed, coursed ashlar 8 inches thick and up to 6 feet long. Some of the stone is full of quartz pebbles. St. Paul's church is rock-face random ashlar mostly gray but showing some pink and tan. The blocks range up to 10 inches thick. So far as observed the native sandstone in these two buildings is in good condition and only slightly stained. The First Presbyterian church is built of Ohio sandstone.

At Tioga stone has not been quarried in recent years. A quarry about 1 mile north of town was the source of the sandstone in the Protestant Episcopal church. The blocks, laid in random ashlar, are not over 5 inches thick, and include red, green, gray, and iron-stained. Some are conspicuously fossiliferous. The rear of the church is much rougher masonry than the front, but all appears sound, in good condition. This stone is fine for local use but probably would not be saleable for shipment because of the mixed colors. It occurs in the Chemung rocks.

Stonework is rare at Lawrenceville and Elkland except the common thin sandstone used for foundations, some of which may have come from a flagstone quarry. Oseola has flagstone walks and stone foundation walls of bluestone from a local quarry that has been idle for a long time.

Westfield has a notable example of local stone masonry in Adams Memorial chapel which is built (1904) of greenish-gray sandstone with small flakes of white mica. The base courses are blocks 8 inches thick and up to 3 feet long; the rest of the building is smaller random ashlar. The stone is soft when freshly quarried, dresses well to rock-face squared blocks and to smooth door steps. A lettered tablet in the front wall shows that it will carve well. The quarry from which this stone came is high on the steep hillside north of the west end of town. A face 70 feet long and 20 feet high is mostly in massive beds. The overburden would increase rapidly if development extended

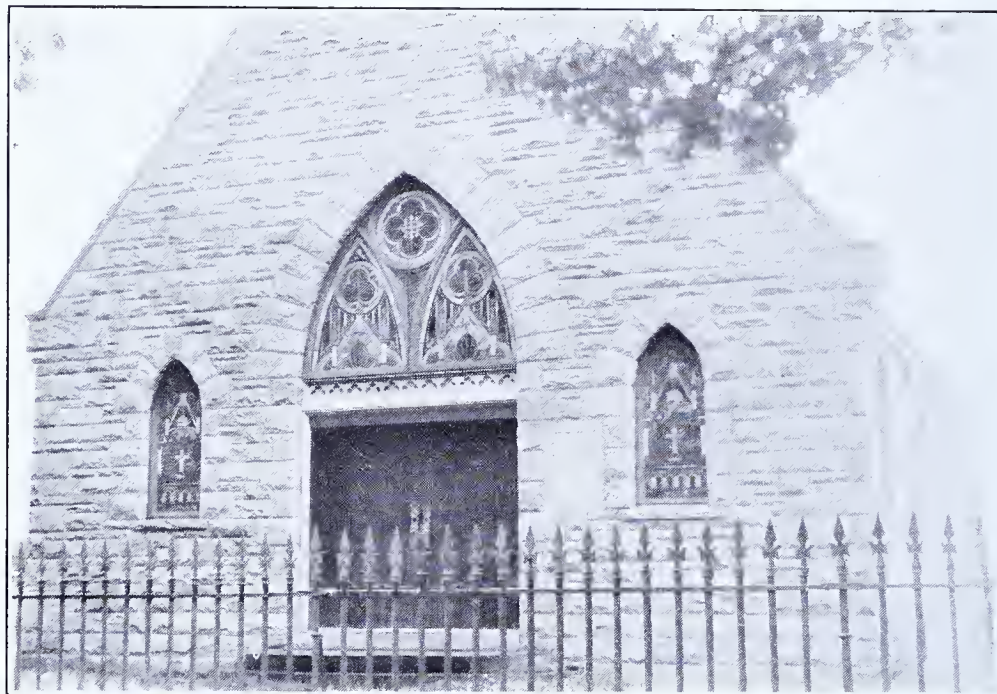


Fig. 152. Adams Memorial Chapel, Westfield, Tioga County, built of Pocono (?) sandstone from near by quarry.

farther into the hill but quarrying along the outcrop looks feasible. The quarry, which is owned by Stott Brothers, has been idle many years.

UNION COUNTY.

Union is a small county in the central part of the State, lying between Lycoming and Snyder, Centre and Northumberland counties. The West Branch of Susquehanna River forms the eastern boundary, South White Deer Ridge is on the north and Jacks Mountain on the south.

The eastern part of the county is mostly shale lowland and the western part is mountain ridges. It is definitely a rural community, nearly 13,000 of the 17,000 inhabitants being classed as rural. The larger settlements are Lewisburg, Mifflinburg, and Laurenton. Lewisburg, the county-seat and site of Bucknell University, has about 3,300 people.

The geological formations exposed in the county include the Silurian sandstones, Clinton shale, Helderberg limestone, Oriskany sandstone, Hamilton shale, and Portage flags. The Oswego and Tuscarora sandstones make the mountains on the north and south borders and in all the western part of the county. On these mountains are considerable areas of flint rock produced by the breaking up of the outcrops into blocks, which are a possible source of building stone. As these mountains are steep, timbered, and almost uninhabited, very little use has been made of the stone.

The Helderberg limestone and Oriskany sandstone make an east-west belt across Gregg Township just north of Spring Creek, and a loop from Lewisburg westward 4 miles and then back through some

low hills to the river two miles north of town. The limestone crops out also in a narrow belt six miles long just south of the highway through Mifflinburg. From this it would seem that the sources of building stone are well scattered throughout the county.

Stone Buildings.

Lewisburg. The buildings of Bucknell University are of brick, but there are several stone buildings in Lewisburg. Christ's Evangelical Lutheran Church (1901) is built of Hummelstown brownstone in rock-face random ashlar, with carved stone work over the door. All looks in very good condition except for weather stains. The First Baptist church is red sandstone in coursed, rock-face ashlar. Some joint face and rusty blocks detract from the general dark tone of the walls. This stone is said to have been quarried on the west side of the river opposite Northumberland and to have been brought to Lewisburg by boat. This being true the stone is probably the red Catskill sandstone. The stone framing of the main entrance, and the front steps appear to be Hummelstown brownstone of later date than the main structure. The Beaver Memorial M. E. Church (1888) is Ohio sandstone in random ashlar. The blocks in the main walls have a bush hammered finish, and the trim has planed faces. Some of the blocks are flaking, especially those smoothed with a planer. Black oil stains are very conspicuous on some blocks. The flagstones at the front of the church also are from Ohio.

Lewisburg Trust & Safe Deposit Company bank (1915) is Vermont white marble, and the Lewisburg National Bank (rebuilt 1926) is Indiana limestone on a granite base; as is also the Union National Bank.

Mifflinburg. Stone masonry is rare in this village. Foundations of the local Helderberg limestone, and of varicolored Tuscarora and Clinton sandstones are the main use of stone here.

Laurelton. All the buildings at Laurelton State Village are of native sandstone from the nearby mountains. Loose blocks of varicolored stone, probably the Tuscarora sandstone, are very abundant at some places on the mountain sides and afford an ample supply of rough material. It is hauled three or four miles by truck to the village and there dressed by hand to rock-face random ashlar. The first building at the State institution was erected in 1914-15 of selected white sandstone from the mountain on the north. The stone in this building in 15 years has become gray and somewhat stained. The office building was put up during the World War; in it red and gray sandstone are mixed, and are holding their color. The newer buildings are of mixed gray, buff streaked, light tan, and red Tuscarora sandstone that was taken "from the sunny side of Little Mountain," or between Little Mountain and Paddy Mountain about 4 miles from Laurelton. The stone in these buildings is tough and resistant to weather, and in this mountain atmosphere should be slow in staining. The colors doubtless will be retained for many years. This group of dormitories and other buildings illustrates the suitability of the Tuscarora sandstone, which is so abundant in the mountains of the central part of the State, for general building.

VENANGO COUNTY.

Although Venango County is rougher topography than Warren and Crawford, which bound it on the north, it has twice as many people per square mile as Warren. Over 50 per cent of the population, however is in Oil City and Franklin, and the production and refining of petroleum forms the livelihood of many of them. The whole county is a high terrace deeply dissected in all directions by narrow ravines and to a depth of 500 feet by Allegheny River, French, Oil, and Sandy creeks. All the upland is underlain by the Sharon conglomerate, and the Shenango sandstone outcrops below it, outlining all the main valleys.

So far as I learned, only four quarries have been active in this county in recent years and all these are operated for the purpose of making silica sand. The Venango Sand Co. of Franklin quarries the Sharon sandstone 400 feet above the Erie Railroad $1\frac{1}{2}$ miles east of Utica. The face of the quarry is about 600 feet long and 65 feet high. As all the stone is to be crushed, the high face is drilled and broken by heavy blasts. It is believed that by using quarry methods this formation would yield blocks suitable for building purposes. By selection, a good, even-grained, gray sandstone could be produced.

The Dick Sand Co. of Franklin is producing silica sand in the bluff of Sandy Creek $1\frac{1}{2}$ miles southwest of Polk. The plant is on the Oil City branch of the Lake Shore and Michigan Southern Railroad and the quarry is about 250 feet above the creek and railroad, and apparently in the Sharon sandstone. The quarry face is about 400 feet long and up to 70 feet high. Some of the formation is very thin bedded and useless for building stone, but other beds are massive, several feet thick between bedding planes, and should yield excellent large blocks for general masonry. All the product of the quarry is now made into sand.

Likewise at Emlenton and Kennerdell large quarries have been developed for silica sand. I have not visited these localities but assume from pictures and descriptions that they could produce large quantities of gray, medium to coarse-grained sandstone on demand. It may be that much of the stone is too soft and friable for building purposes but in a quarry face 2,000 feet long and 30 to 40 feet high, as in the Pittsburgh Plate Glass Co. quarry at Kennerdell, there should be some suitable stone. A smaller quarry $1\frac{3}{4}$ miles above Kennerdell also is producing sand but might yield building stone. These quarries are in the cliff about 400 feet above the river and are in the Pottsville series.

Three quarries were operated years ago at Franklin for building stone and flagstone. But much of the stone formerly used and all that taken locally now is obtained by breaking loose blocks on the surface. The Bell quarry on the 15th Street hill yielded a large quantity of flags as well as building stone. The ledge is 10 feet or more thick, but has a heavy overburden; the quarry was used for building sites some years ago. Other quarries now abandoned are in the bluff of French Creek opposite the city park, and back of the Atlantic Refining Co. plant. Many sidewalks in Franklin are of local flagstone, and many are of sawed Ohio sandstone.

In 1928 when the 14th Street brick school was remodeled, the foundation of local sandstone was redressed (at one end at least). The weathered stone was dark, even black in places but the cleaned stone is

gray, greenish, pinkish and light brown streaked, medium grain sandstone. The fresh stone looks very well but is bound to be stained in a few years by soot. Blocks in this foundation range up to 4 feet long and 7 inches thick.

The First Methodist Episcopal church at Franklin is of brownstone and the Lamberton National Bank is white marble, probably from Avondale, Chester County. The marble is in large blocks with sawed faces, and is still clean though built in 1912. The Exchange Bank & Trust Co. building on the opposite corner is of sawed Indiana limestone and shows streaked stains a year after it was built in 1927. The base is fine-grained polished gray granite.

At Oil City I learned of no quarries but noted the Second Presbyterian church, a fine big building in random ashlar, rock-faced Indiana limestone (1913), the Good Hope Lutheran church (1902) of Hummelstown brownstone now weathered dark and stained black, and its parish house (1927) a light chocolate-brown. St. Steven's Catholic church (1906) is of sawed Cleveland sandstone in regular courses, and Trinity Methodist Episcopal church is rough-faced Buffalo sandstone.

Where the Lakes to Sea highway crosses East Sandy Creek several miles east of Franklin, blocks of Pottsville sandstone 10 to 15 feet across lying along the road show the kind of material that is available throughout much of the upland in this county.

WARREN COUNTY.

Warren County is on the northern boundary of the State between Erie and McKean counties. It was named for Joseph Warren who fell in the battle of Bunker Hill. The county is variously recalled as the site of the Cornplanter Indian Reservation, the Tidioute oil pool, West Pennsylvania State Hospital, and of a mail order house at the county seat.

Although Warren County, with an area of 902 square miles and a population of 40,000 has an abundance of good building stone everywhere except in the townships along the State line west of Conewango Creek, I did not learn of one operating quarry. This is partly because very little local stone is used now for building, and largely because the massive sandstones and conglomerates break off from the ledge in large blocks which strew the surface and need only to be broken up to furnish an ample supply of building stone. Where blocks of sandstone 10 to 20 feet across lie on the surface there is little inducement to open a quarry. In spite of the lack of quarries, some notable building has been done with local stone, obtained by breaking up loose blocks. Two buildings at Warren are worthy of mention—the Methodist Episcopal church and the State Hospital.

The Methodist Episcopal church was built in 1925 of sandstone taken from loose blocks found 3 miles southeast of the church. Stone for the lower half of the church came from Browns Run and for the upper half from Morrison Run. These runs are tributary to Tionesta Creek at its mouth. The beds of the runs, the banks, and the wooded hillsides were strewn with blocks of Olean and sub-Olean conglomerate which, when broken, yielded material of even grain and color. Selection was made of blocks free or nearly free of pebbles, and only the gray stone was used for facing. Stone that was stained or streaked, but otherwise sound, was used for backing. When all the desirable

stone at the lower end of Browns Run had been taken, operations were moved to Morrison Run. The stone was dressed on the job and laid as rock-faced random ashlar. Few of the building stone are over 2 feet long and many are not over 8 inches thick. The tone of the walls at present is gray and probably will remain so for several years. The writer believes it likely that eventually the stone may weather to a greenish-gray and also become darker by smoke staining. At it stands today the Methodist Episcopal church at Warren is a fine job of masonry, marred only by the use of cast stone for water table and trim.

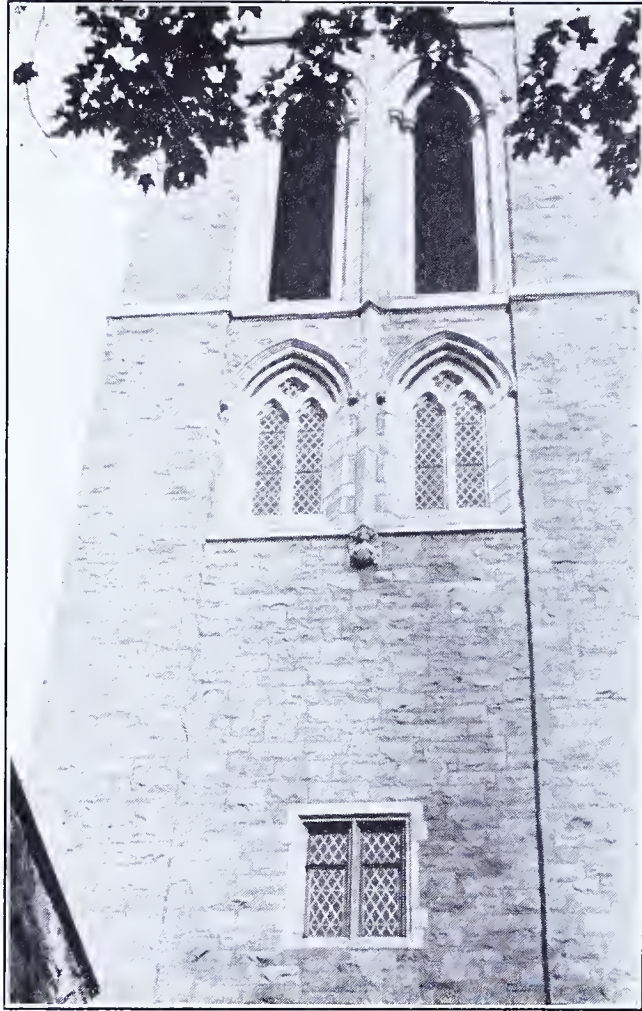


Fig. 153. Methodist Episcopal Church, Warren, built of Olean sandstone taken from loose blocks on Browns and Morrisons Runs.

The State Hospital at North Warren, formerly known as the West Pennsylvania Insane Asylum, was begun in 1876 and received its first patients in 1880. The main building is 1,200 feet long and was built of stone taken on the north side of Follett Run about $1\frac{1}{2}$ miles southwest of the hospital. Follett Run enters Conewango Creek at the mouth of Jackson Run and it was on the north hillside from half a mile to a mile up the hollow that the stone was taken along the out-

crop of the Olean(?) conglomerate. Very little quarrying was done because loose blocks were abundant. Stones for the face of the walls were squared and dressed by masons whose wages were \$1.00 to \$1.25 a day. Stone for trim was dressed by hand to a smooth face. Many blocks in the base courses are 2 feet by 10 inches; sills are 7 to 8 feet long and 1 foot thick. The stone is fine-grained, clear quartz sand, mostly weathered to a yellowish green, though some retains the original gray color.

An old building of native sandstone in Warren is that on Fourth Avenue near Main Street owned by the Philomel Club. It is a plain two-story structure, of blocks ranging in size up to 5 by 1 foot by 8



Fig. 154. State Hospital at Warren built in 1872 of sandstone quarried on near by hill.

inches, smooth-faced, weathered to a buff or iron-stained color. The building is said to be about 100 years old, and was formerly a hotel, the Mansion House. The sandstone is durable but its color now is not pleasing.

The First Presbyterian church in Warren is built of Ohio sandstone, and the old part of the Warren Savings Bank is Hummelstown brown-stone.

The principal stone in Warren County suitable for building purposes is the Olean conglomerate. This massive, coarse-grained rock underlies or caps the highlands of the southern half of the county and its loose blocks strew the steep slopes below it. The Olean also caps some ridges north of the Allegheny and Brokenstraw. The Sub-Olean conglomerate rims many ravines throughout the county and the Chemung flags are above water for several miles south of the State line in the Allegheny, Conowango, and Stillwater valleys.

According to Fettke¹ the Pottsville sandstone was quarried on the upland $13\frac{3}{4}$ miles from Torpedo for glass sand, and at two places near

¹ Fettke, C. R., Glass manufacture and the glass sand industry of Pennsylvania. Top. & Geol. Surv. Comm. of Pa., Rept. XII, pp. 255-258, 1919.

Althom for the same purpose. In the quarry of the Warren Silica Co. near Torpedo was a massive, white, quartzitic sandstone 12 to 25 feet thick. In places it had a pinkish tinge. The quarry face was about 680 feet long in 1914, and from the description, would seem to be a possible source of building stone. Similar stone occurs in a quarry on the top of the hill on the west side of the river about one mile north of Althom.

There is no limestone in Warren County.

WASHINGTON COUNTY.

Greene and Washington counties are very similar geologically. The strata exposed at the surface are confined to the Conemaugh, Monongahela, and Dunkard groups, or Upper and Lower Barren, and Upper Productive Coal Measures.

These strata include the Vanport, Ames, Benwood, Waynesburg, and Upper Washington limestones as well as several other limestone beds. Although some of the beds are several feet thick the individual layers may be thin, or where thick enough for building stone they are difficult to dress. They range from coarse-grained and fossiliferous to fine-grained and non-fossiliferous, range in color through shades of gray and blue to nearly black, and have been used principally in building roads. Another former common use was for agricultural lime. The use of native limestone for building purpose was rare. Two buildings, possibly of Upper Washington limestone, erected in the early days, are still standing. One is the Bradford house (1788) a 2-story residence at 174 South Main Street, Washington, the first floor of which has been converted into a store used by P. H. Butler Company. The limestone is weathered yellow and stained black, but is perfectly sound after 140 years.

The only other limestone building in Washington observed by the writer is the middle part of the Administration Building (1793) at Washington and Jefferson College. The walls are rough coursed, dove-colored limestone weathered yellowish and partly stained with soot. Its perfect condition indicates the durability of the limestone.

Sandstones also are abundant and widely distributed in Washington County, but for the most part they are flaggy and weather to a greenish brown that is typical of many Coal Measure sandstones and cannot be classed as a pleasing color. Rarely is the bedding sufficiently massive and regular for dimension stone. Many small openings have been made, of course, for stone to use in rough masonry foundations for houses and barns, but whole buildings of native Washington County stone are rare. Farm buildings of brick made locally are common.

The principal sources of building stone are the Morgantown, Pittsburgh, Waynesburg, and Washington sandstones. Of these the Morgantown sandstone is generally heavy-bedded but in places is flaggy; the Waynesburg is coarse-grained, thinly laminated, and cross-bedded; and in a few places the Washington sandstone is massive. Where this condition exists this stone can be worked for other purposes than rough masonry and foundation for macadamized roads. The principal places where the sandstone overlying the Washington coal has been worked for dimension stone are on the National Pike 5 and 6 miles west of Washington. On the Haggerty farm $\frac{3}{4}$ mile northwest of

Coffeys Crossing, which is 5 miles west of Washington on the B. & O. R. R. the railroad company ran a spur up to the head of a small valley and quarried a large quantity of flag and dimension stone. The quarry, which has been abandoned for many years, has a face about 300 feet long and up to 30 feet high. The upper part of the ledge is irregularly laminated, thin-bedded gray sandstone and the lower part massive-bedded, but separated into layers by shale carrying iron nodules. The massive beds are soft and coarse-grained and tend to split as if cross-bedded. The overburden is too heavy for further operation, but the same ledge could be uncovered near the railroad.

Another quarry in this sandstone is that which furnished the stone for the famous "S" bridge over the east fork of Buffalo Creek on the National Pike about 6 miles west of Washington, and for other stone bridges on this route. The quarry is on the John M. Burrows farm (now occupied by W. C. Ramsey), $\frac{1}{2}$ mile south of the pike at the "S" bridge, and in the west bank of the creek. The face is clearly exposed over 500 feet long on a single ledge of massive sandstone 20 or more feet thick. The overburden includes 10-20 feet of thin-bedded sandstone. Some of the main ledge is clear quartz grains with numerous specks of a black mineral; some contains a high percentage of feldspar; but the color of stone for highway bridges was inconsequential in those days, the main needs being durability and workability. This massive ledge would work into dimension stone. Later the B. & O. Railroad ran a switch to this quarry and took out much stone for bridge building. The quarry has long been idle and poplar trees measuring up to 12 inches at the base are growing on the waste.

The "S" bridge has two arches of rough coursed ashlar. The dressed stones facing the arches still show the numbers cut in them. The coarse-grained sandstone, originally light gray to tan is weathered to medium gray. For some unexplained reason many stones on the down stream side of the bridge were as clean in September 1929 as if recently sand blasted.

Sandstone was quarried at other places in this part of the county, including about $\frac{1}{4}$ mile west of Woodell station, and $\frac{1}{2}$ mile southwest of Bavington, but not in recent years.

At Pancake, a settlement on the National Pike at the east side of Washington a quarry was opened years ago about 200 yards north of the pike in a sandstone about 130 feet above the Upper Washington limestone outcropping at the entrance to a near by tunnel of the B. & O. Railroad. This quarry was operated by Hallam Construction Company up to about 1905 for building stone, mainly for bridges, and for curbstone. This sandstone is medium-grained, contains more or less feldspar, and weathers to a greenish brown to dark gray. The quarry is sizable and seems to have been worked back to the limit of movable overburden. It is now completely overgrown with locust trees, briars, etc. Another quarry in this sandstone in the woods south of the highway at Pancake has been idle many years.

Stone Buildings.

The oldest stone building in Washington, and perhaps in the county is the Bradford house (1788) two doors above the Ault Hotel. It and the Administration Building (1793) at W. & J. College were mentioned above. Another old house is that of J. J. LeMoyné (1813) at 49 East Maiden Street, on the National Highway. It is stained very

dark with soot but where spalled around the base is seen to be gray siliceous sandstone, which undoubtedly was obtained from a local ledge, if it was not float stone. The front of the building is coursed ashlar but the other walls are rubble. Except for slight spalling at the base and porch, the stone seems not to have deteriorated.

Old Main (1873) at W. & J. College is red brick with Ohio sandstone trim. The terrace and balustrade are Indiana limestone. The gymnasium is Ohio sandstone, cleaned by sandblasting in 1928. The County Court House (1901-07) is massive cut sandstone, probably from Ohio. Pillars and other ornaments are granite. Many fine Ohio flagstone walks are still in use in Washington, though some flags are worn decidedly hollow.

At Claysville the local sandstone has been used only in foundations and retaining walls, usually as rubble. When dressed to ashlar and weathered yellow it looks neat.

Canonsburg's oldest buildings are brick, but the 3½ story brick Jefferson College (1833) is on a dressed coursed ashlar foundation of local gray sandstone in good condition. This stone is said to have come from the Phillips farm 5 miles northwest of Canonsburg. The Polish Catholic Church (1914) at Canonsburg looks like Hummelstown brownstone in the first story, and yellowish Ohio sandstone above.

Monongahela City, Charleroi, and other river towns have very few stone buildings. Those seen by the writer are local sandstone either painted or very grimy with coal soot. Ledges along the river bluff would furnish stone for building but it is not wanted in these coal mining towns. Through the country all-stone buildings are rare, and the few seen are of local Coal Measure sandstone; as examples, a house and small hotel at Scenery Hill. This hotel, the Century Inn (1794), is said to have been kept continuously as a tavern longer than any other on the National Pike.

The oldest building in Monongahela Valley is the home of Andrew McFarlane near Elrama, on Monongahela River near the northeast corner of the county. Part of this house is native stone and was erected about 1783.

WAYNE COUNTY.

The northeasternmost county was named for General Anthony Wayne, hero of the Revolution. Like Susquehanna County which joins on the west, it is notable for the large number of natural ponds made by glacial deposits damming the original stream courses. The topography is very hilly, and along the Delaware is a bluff about 500 feet high. Much of the area is forested.

The geology of Wayne County was described by White¹ about 50 years ago. He found the entire county underlain by sandstone and shale of Catskill age, except a narrow band on the west border in Moosie Mountain containing Pocono and basal Pottsville beds. White divided the 1,500 feet of undoubted Catskill in this way:

¹ White, I. C., *Geology of Susquehanna County and Wayne County: Pennsylvania Second Geological Survey, Rept. G5, 1881.*

	<i>Feet</i>
Mt. Pleasant red shale	150
Elk Mountain shales and sandstone	150
Cherry Ridge group	170
Honesdale sandstone	90
Montrose red shale	180
Paupack sandstone	25
Paupack shales	200
New Milford group	460
Starrucea shales	105
Total	1,530

The Cherry Ridge group contains a 20 foot conglomerate at the top, a grayish-white, very hard rock filled with reddish quartz pebbles. This conglomerate is conspicuous in the higher elevations of southern Wayne County and the group takes its name from a good exposure in a knob just west of Cherry Ridge. The group includes 15 feet of sandstone about 20 feet below the conglomerate. The Honesdale sandstone is divided into an upper white member 25 feet thick, a middle red member 40 feet, and a lower gray member 25 feet thick, well exposed at Honesdale. The upper member is so nearly white that it is easily traced from hill to hill, but on a freshly broken face the stone is grayish-brown owing to numerous specks of iron oxide. It is exposed in a long line of cliffs one mile south of Honesdale. The middle red member is the only red sandstone in the Catskill series. It is hard, fine-grained, and thin-bedded. It caps Irvine cliff opposite Honesdale. The gray sandstone at the base of the Honesdale group is quite massive, usually current-bedded, and conglomeratic in the southern part of the county. It forms two miles of cliffs along Dyberry Creek above Honesdale.

The Paupack sandstone, probably confined to southern Wayne County, is a bluish-green, serpentine-like rock well exposed just above the mouth of Wallenpaupack Creek. The New Milford group is mostly gray and greenish-gray sandstone and outcrops in the northwest part of the county. According to White, the New Milford lower sandstone is a dark greenish-gray bed on Starrucea Creek and makes excellent building stone near Stevens Point, which is just over the line in Susquehanna County.

At Griswold Gap in Clinton Township, a very hard coarse conglomerate is abundantly exposed. It belongs in the Pocono series, is whitish, and contains innumerable angular and generally flattened white quartz pebbles. This conglomerate occurs also in Moosic Mountain in Canaan Township.

The pebbly sandstone of the Cherry Ridge group is widely distributed in the southern half of the county and is seen in cliffs capping a north-south ridge through the center of Oregon Township.

The Honesdale lower sandstone, quite massive and white, and 35 feet thick, occurs in cliffs along the high divide through Scott Township; makes great cliffs 2 miles east of Lake Como in Buckingham Township. Honesdale sandstone also is seen in cliffs and strewn over the ground in large masses in the hills in the southwest corner of Manchester Township; just west from Upper Woods pond in bowlders

“larger than a good sized house”; and is exposed in almost continuous cliffs along the banks of Dyberry Creek. The Honesdale lower sandstone is 175 feet or more above the creek road at Honesdale.

The Paupack sandstone 35 feet thick had been quarried along the bluff just above the creek road at Honesdale before White was there in 1880. He describes it as a greenish-gray rock which, seen in a building from a distance, looks like serpentine. The Protestant Episcopal church and the Catholic church in Honesdale were largely constructed of this rock, and the silk factory built in 1880 at the falls of Paupack just south of Hawley is of this same sandstone that was quarried on the Pike County side of the creek $\frac{1}{4}$ mile above the first cascade. It is in layers 4 to 8 inches thick and dresses neatly to good building stone.

White mentions other localities where these different sandstones are conspicuously exposed, including Ledgeville in Salem Township, which is named from immense ledges of pebbly sandstone on each side of the gorge of Wallenpaupack Creek, but he speaks of only two quarries, the one at Honesdale, and one in grayish-brown sandstone just north of Waymart, from which excellent flagging was obtained. Wallenpaupack Lake, formed by building a dam at Wilsonville, has partly submerged the ledges at Ledgeville and the settlement has been removed.

My own observations in this county were made in 1922 and 1929. The large flagstones used for sidewalks in Honesdale attracted my attention and I was directed to the largest one in town which is in front of the home of Mrs. Ann O’Connells, 514 Church Street. It measures 7 feet 11 inches by 22 feet 3 inches and is about 4 inches thick. (See Fig.). It was quarried at White Mills, about 6 miles down Laekawaxen Creek. The durability of the local flags when of proper thickness and laid with good foundation is shown by many of those in the business section. That in front of the tobacco store of Wm. J. Ferber was laid about 1876 and is in perfect condition after 50 years of constant service. All the flagstone in Honesdale is said to be of local origin. The only flagstone production in the vicinity in 1922 was coming from about 1 mile south of Aldenville where John H. Bowen was working alone in his spare time getting out flags which he sold in Honesdale. Two large flagstone quarries near White Mills were idle in June 1929 but it was reported that the Klink quarry two miles east was to be operated that summer by a Mr. Grady. This quarry is said to have employed 15 men for two years and to have a 40-foot face, including 20 feet of waste rock. The massive ledge was worked for curbing and flags. Spinner’s quarry on a hill one mile west of White Mills is said to have too much overburden now for profitable working.

I saw very small flagstone quarries along the road at Como Lake and was told that the flag quarries at Starlight were equally small and had not been worked since about 1914. Between Preston Park and Starucca near Shehawken Lake is the Nathan Leet quarry where flags were taken for six years but operation ceased about 1908. Curbstone and flags produced here were shipped to Binghamton. The upper few feet of sandstone exposed in the quarry are irregularly bedded and underlain by a bed of “worm-eaten” sandstone that is 4 feet thick at the outcrop but pinches out in the quarry face. Below is 8 to 10 feet of massive gray sandstone that furnished most of the product.

Bluestone quarries have been worked at Stalker, Equinunk, Lords-

ville, and other points along Delaware River, producing flagstone, curbstone, and coping. There has been little demand for stone from these quarries in recent years and most of them are idle. Probably the most recent shipments of bluestone from the northern end of the county have been made by Ed. McCloe from quarries near Starrucca.

Grace Episcopal church (1853) on the square at Honesdale and the adjoining rectory (1875) are of massive, coarse-grained sandstone weathered to greenish gray. Some blocks contain shale pebbles, and a few are noticeably pink. The church is rock-faced random ashlar and the rectory margin-draft, coursed ashlar. Blocks range up to 20 inches thick and 5 feet long. Smooth-dressed faces around the church door are sealing, probably because the impact of the tool loosened the bond between the grains to a slight depth. Otherwise this masonry appears sound. Curiously the steeple of this church also is stone.

The Roman Catholic church (1876) at Honesdale is Paupack sandstone from a local quarry, laid in rock-face random ashlar. Blocks are up to one foot thick but mostly 6 to 8 inches, and up to 4 or 5 feet long. In this church the dressed stones around the door have not sealed. For many years this church was heavily covered with ivy, so the walls are stained irregularly. The ivy was removed in 1928 and the general tone of the wall now is dark gray.

Hotel Allen, Honesdale, built by Mr. Allen about 1874, is claimed to be the first concrete building erected in the State. Local sandstone was broken with sledges on the job, the concrete was mixed by hand, carried up ladders and dumped in forms without reinforcing. The present proprietor says that the difficulty in cutting the concrete recently to enlarge a window opening demonstrated the strength of the wall.

The Honesdale National Bank (1896) is massive rock-faced ashlar of gray sandstone with rare quartz pebbles. This stone came from Forest City. The trim is Indiana limestone. Honesdale Dime Savings Bank and Wayne County Savings Bank are Indiana limestone on granite base.

Just below White Mills ledges and large blocks of bluestone are conspicuous at road level, but in some the bedding is irregular. At Honesdale, White Mills, and Hawley retaining walls along Lackawaxen Creek, and many yard walls and pasture fences are of local sandstone rubble. Some yard retaining walls and home foundations are of trimmed bluestone flags.

At Hawley several stone buildings were noted. The First National Bank (main part 1902) is rock-face, random ashlar, bluestone from Lanesboro, Susquehanna County. The rock-faces have soiled unevenly and the whole exterior may be cleaned with sand blast. The window quoins and lintels are rubbed or sawed faces and much lighter color. The only imperfection observed was one scaled quoin. The Hawley Bank (1929) is Indiana limestone on limitation granite east stone base.

The old stone house at Church Street and Chestnut Ave., Hawley, now owned by J. W. Murray, was built about 1843 of bluestone rubble probably from the ledge at the back door. The large corner quoins are unusual.

The silk mill on the hill at Hawley is rock-face, coursed and random ashlar from a bluestone quarry half a mile up the creek. Most of the blocks are less than 6 inches thick and many are barely 2 inches. All

are sound except where the wall has settled and cracked. Some of the stone is stained black but the clean stone has a greenish hue. A smaller mill in the ravine immediately below is of the same stone.

Two miles south of Hawley is the concrete dam that makes Lake Wallenpaupack, the largest lake in Pennsylvania. In the hill west of this dam and 1,000 feet from Route 6 is the old quarry that was worked years ago by Cornelius Diamond, by Kilgore, Collingwood and others, and in 1929 was being worked by Croon & Company of Hawley. It is still known as the Diamond quarry. When the industry was active 40 to 45 years ago, about 30 men were employed here. Although I saw only 250 feet of quarry face it is easily believed, as I was told, that the face is twice that long but now buried under waste and overgrown. The bluestone ledge is massive, 15 to 20 feet thick, and is worked along straight smooth joint faces. The stone is blue to bluish black and green; some faces are micaceous. Flags and curbing are the principal product, and are marketed through Kilgore at White Mills.

At Newfoundland, in the southern end of the county, the rough bluestone ashlar in the First National Bank and foundation of the public school was broken from large float blocks on the hill between Newfoundland and Gouldsboro. This use of natural stone of local origin in a village bank is to be commended as it indicates conservatism and economy coupled with durability. That the stone is hard is indicated by the fact that the State Highway Department was crushing a sandstone just south of Newfoundland in 1929 for road metal.

At Gouldsboro Grace Evangelical Luthern church (1876) is of blue and green sandstone and red conglomerate field stone, and St. Rita's Roman Catholic church (1921) is built of red conglomerate in rock-face random ashlar. The pebbles, mostly under $\frac{1}{2}$ inch, are white quartz and the matrix in the sunlight is pale or faded red. This material is obtained from loose blocks of the Catskill formation that strew the surface in some areas near by. It is strong, very durable, and can well be used in forest land villages where it is free for the taking.

From all of the above it may be gathered that the bluestone of northeastern Pennsylvania suitable for flags, curbs, sills, doorsteps, etc., is available at many places in Wayne County, and that building stone suitable for local needs at least can be had in every township. Little use has been made of these resources as yet, partly because of the fact that much of the county is a thinly settled wilderness.

WESTMORELAND COUNTY.

This large county in the southwestern part of the State lies west of Laurel Ridge and south of Kiskiminetas and Conemaugh rivers. It was named for a county in England whence some of the early settlers came. The geologic section exposed in this county includes a small patch of Catskill shale and Pocono sandstone brought above water level on Conemaugh River by the Chestnut Ridge anticline, the Mauch Chunk red shales that are exposed in a broad belt on Laurel Hill, and the Coal Measures up into the Upper Barren or Dunkard group.

Here then may be found the Pottsville conglomerate along the west flank of Laurel Hill and on the crest of Chestnut Ridge, and the sandstones of the Coal Measures in Ligonier Valley and all the county

west of Chestnut Ridge. The geologic section and distribution of formations are very similar to Fayette County. Among the rocks exposed are several limestone beds that have been used for building roads and have been burned for agricultural lime. These have been used rarely if at all for building stone, with the exception of the Siliceous or Loyalhanna limestone which occurs between the Mauch Chunk red shale and the Pocono sandstone. On weathered surfaces this rock shows only a mass of quartz grains and its limy character would not be suspected. It may show bands of coarse and fine particles, and in outcrops crossbedding may be conspicuous. The freshly quarried and broken rock suggests its limy character, has irregular fracture, and shows no bedding. It was burned locally for lime in pioneer days and did not require the addition of sand to make plaster. In recent years large quantities have been quarried to crush for road metal, railroad ballast, and coarse aggregate in concrete, and to dress into paving blocks, curbstone, and building stone. A large quarry in the Loyalhanna limestone operating in 1929 is that of Booth & Flinn on the Lincoln Highway at Long Bridge (McCance Post Office) about 5 miles west of Ligonier.



Fig. 155. Loyalhanna limestone in Booth & Flinn quarry at Long Bridge near McCance, Westmoreland County.

This quarry is on the north side of Loyalhanna Creek in the gap through Chestnut Ridge. It has a working face half a mile long that exposes 60 feet of siliceous limestone and 25 feet of overlying gray sandstone. The limestone is called bluestone from its color. In spite of irregular fracture it dresses nicely and makes tough paving blocks, which have been used very extensively in paving streets in Pittsburgh. The present quarry has been operated 40 years or more. Its daily output is about 800 tons of crushed stone. A considerable stock of paving blocks, known as Ligonier blocks, is kept on the quarry floor. An abandoned quarry in the opposite bluff is half as large and was operated by Booth & Flinn. These quarries have furnished building stone of good quality. An example is the Presbyterian Church (1904)

at Ligonier in rock-faced coursed ashlar blocks 6 to 8 inches thick and 1 to 2 feet long, and all weathered to a medium gray. The trim is a darker sandstone supposedly from the same quarry. A little flaking has developed around the base, but it is barely worth mentioning.

Other large quarries in the Loyalhanna limestone operated by Booth & Flinn are located a few miles farther north on the west slope of Chestnut Ridge. One equally large is on Hillside Run, another on Bridges Run, and a third on the summit at the head of Tannery Hollow and reached by a railroad branch from Packsaddle on the Conemaugh.

The Loyalhanna limestone is quarried also on Chestnut Ridge 3 miles south of Baggaley. The original quarry directly on the road over the ridge is no longer worked. It is 150 feet long and exposes about 25 feet of the limestone. A road from the Standard scales at this quarry leading down to the run brings one in 300 yards to a larger quarry opened in 1928 by the Westmoreland Bluestone Company of Greensburg. By means of blasting and an Erie caterpillar shovel a face about 400 feet long and 30 to 40 feet high has been partly developed (September 1929) on this limestone and the sandstone that overlies it. Machinery has been installed for fairly large scale production of crushed stone and paving blocks. The product must be hauled by truck about 3 miles to Whitney for shipment by rail. Dimension stone could be made if demanded.

The Pottsville sandstone on the east side of Ligonier Valley and on Chestnut Ridge is suitable for building stone but has been little used. Quarries have not been opened in it because the large float blocks furnish all the stone needed in or near the sparsely settled areas where it outcrops.

The Saltsburg sandstone in the Conemaugh group is hard and massive, and has been quarried for many years on the hill 1 mile southeast of Hunkers. The stone is light tan, weathering gray; some is soft and sugary, but a bed 8 feet thick without parting will yield large dimension stone. Rock was quarried here by the Pennsylvania Railroad for bridge and tunnel work, and used in the Rodebaugh tunnel, embankment along the railroad in East Liberty, and in bridges on the Yukon Branch. The quarry was shut down about 1907 but started again in 1921 producing silica sand for steel mills. In 1928-29 float stone from the land of Mason Welty in this vicinity was used very effectively in building the Shoemaker residence, 570 Maple Avenue, Greensburg, and the F. P. Underwood residence, Latrobe. The stone is light tan, pink, and gray. Some blocks are one color, some are blotched or banded in two colors, or marked with thin brown weather lines. The stone dresses nicely to ashlar and the colors blend into a pleasing warm tone. As thousands of years of exposure have bleached only a mere film of the surface it may be assumed that this stone will retain its color for many years. The color of course, may be hidden by an accumulation of soft coal soot.

Other sandstones in this county are the Mahoning, Morgantown, Connellsville, Pittsburgh, and Waynesburg. For the most part they are suitable only for rubble work, being generally flaggy, but where massive-bedded they are capable of producing building stone, if one does not mind the greenish brown color to which it weathers.

Stone Buildings.

Greensburg. The Court House is granite not native of this State. Originally it was light gray, but parts of the building now are nearly black with coal soot. The First Presbyterian Church is Plymouth (Mass.) seam-face granite. Church of the Most Holy Sacrement (1926) is sandstone from Neshannock Falls, Lawrence County, as is also the Sacred Heart Church at Jeannette, and the M. E. Church at Irwin. The general effect of the Neshannock sandstone is gray although some blocks are rusty. In the churches the ashlar range up to 8 by 24 inches, and 12 by 18 inches. Trimmed with Indiana limestone it makes an imposing church. Like all rough-faced stone, where exposed to the soot-laden air of these soft coal fields it becomes stained black in a few years.

Christ Church Episcopal (1889) and the First M. E. Church are gray siliceous sandstone that may have been quarried locally, for stone used to be quarried where now is the ice plant and ball park. These buildings, though probably handsome when new, are now black with soot.

Many foundations and lawn retaining walls in Greensburg are native sandstone from this source. Cleveland, Ohio sandstone is a favorite stone for ashlar foundations here as it dresses to neat rock-face, sharper in detail than the local sandstone which tends to more rounded faces. Ohio flagstones have been much used for sidewalks in Greensburg.

Latrobe. The Roman Catholic Church (1905) is gneiss from Holmesburg, Philadelphia County. The random ashlar in blocks not larger than 1 by 2 feet has kept clean in the upper walls, but the water table and ashlar with high relief are black with soot. The trim is Indiana limestone.

Christ Reformed Church (1901) is a native gray sandstone said to have been quarried on the Sloan farm. The largest ashlar are about 10 by 36 inches. It has weathered to a greenish color, but window sills, buttress caps, and blocks with high relief are now black with soot, giving to the whole building a wretched appearance. Where the exposed faces have sealed recently the clean gray sandstone is exposed.

People's National Bank of Latrobe (1927) is a handsome building of Indiana limestone on a base of Mt. Airy (N. C.) granite. The first story of the First National Bank also is Indiana limestone but very much soiled.

Pennsylvania Railroad underpass is built of massive, coarse-grained sandstone blocks 2 feet thick and 6 to 7 feet long—source not learned.

At New Alexandria I saw but one stone building "Ye Old Stone Inn" built of field stone rubble in 1800. This sandstone is now very black except where the surface has sealed off.

Mount Pleasant. The local sandstone used for cellar walls and lawn walls is thin, slabby and of greenish brown color. Some beds yield blocks 6 to 8 inches thick but these are exceptional. The better masonry in Mount Pleasant is Ohio sandstone.

West Newton. The First National Bank is light tan Ohio sandstone with indistinct banding. Farmers & Merchants Bank is a medium-grain, greenish-tan, massive sandstone from the west bank of Youghiogheny River near by. The bank was built about 1900 and the addition about 1915. Water sills 15 inches thick and 6 to 8 feet long indicate the character of the bed and some ornamental carving shows its workability.

As West Newton is a hillside town many lawns on the upper side of streets are supported by retaining walls. The common building material for these walls is slabby sandstone reported to have been quarried in Polluek Run. I found a quarry in this run exposing about 25 feet of limestone, in thick and thin beds, light and dark, breccia and homogeneous. The lower 4 feet is massive, light gray, and might make attractive building stone if it will dress well.

Sandstone outcrops near the top of the hill on the highway just east of West Newton and a massive bed 3 to 4 feet thick has been quarried there.

Ligonier. The Methodist Church facing the park contains three different stones. The base is an even-grained quartz sand on the surface but may be limy; the water table is sawed Ohio sandstone, and the main walls are a greenish-gray stone with thin streaks of quartz grains in a fine matrix. This stone is said to have come from a quarry on Laurel Hill about 6 miles south. The quarry has not been worked for 15 years or more, or since the lumber railroad was abandoned. I think this is the Loyallhanna or Siliceous limestone.

The Presbyterian Church (1904) is similar stone, said to be from the Loyallhanna limestone quarry at McCahee.

The Ligonier public school, of yellow brick with Indiana limestone columns and trim, is on a foundation of native sandstone ashlar from the Menoher quarry on the Lincoln Highway two miles east of town. The stone has the greenish-brown color typical of the Coal Measure sandstones. This quarry has long been idle.

The First National Bank has a front of Indiana limestone and the National Bank of Ligonier is faced with light pink Tennessee marble.

New Kensington. Homewood sandstone from the Ellwood Stone Company quarry at Koppel, Beaver County, was used in the bridge over Allegheny River.

Monessen. The Jefferson grade school on McKee Avenue has a walk and flights of steps made of flag raised in a 100-year old quarry about one mile west of Smithton. This quarry is on the old Porter farm, now owned by Charles Brantthoover. This buff-colored sandstone can be raised in blocks up to 12 inches thick. The irregular stones of various color in the rock garden at this school came from the Washington mill site at Perryopolis.

A quarry near Webster on Monongahela River has furnished much flagstone for walks in Pittsburgh.

WYOMING COUNTY.

Situated in the northeast corner of the State, between Susquehanna and Luzerne counties and crossed by the North Branch of the Susquehanna River, Wyoming County is partly trackless wilderness and partly farm country. The Susquehanna crosses it diagonally in a crooked course and deeply intrenched below the upland. At Nicholson in the northeast corner of this county is the famous high concrete bridge of the D. L. & W. R. R., and at Factoryville, the home of Christy Mathieson, baseball player.

The rocks through much of the county are Catskill beds, like Pike County. In the southwest the higher upland is underlain by Pocono sandstone and conglomerate, and in the northwest corner along the

river, beds of Chemung age are exposed. Here the bedrock comes to light in the steep walls and cliffs along Susquehanna River, just as in Pike County the principal rock exposures are along Delaware River. The quarry sites are in the bluffs or in the bottoms of ravines close to the river, and on the north side of the river because the railroad is on the that side.

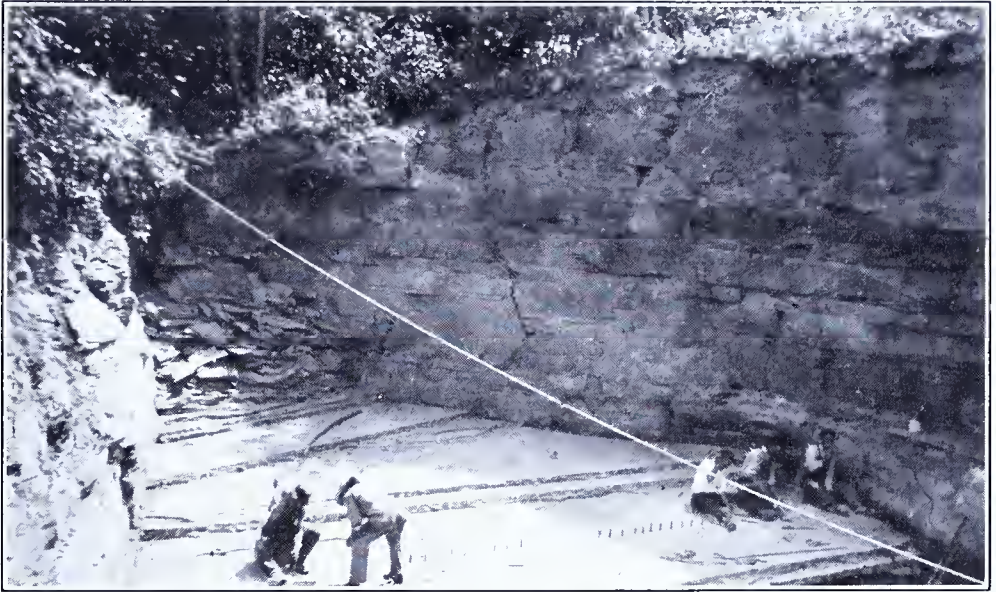


Fig. 156. Flagstone quarry 1.7 miles west of Meshoppen, Wyoming County.

Stone quarrying was the only mineral industry in Wyoming County when I. C. White studied this area in 1882 for his report G 7 of the Pennsylvania Second Geological Survey. I believe it is today also, and at least one of the quarries he mentions was operating when I was there in 1927.

White mentions the following localities:

A short distance above Skimmers Eddy a fine-grained sandstone was quarried in large quantity on Tuscarora Creek for lintels, stepping stones, etc. At the outcrop stones 4 to 12 inches thick were raised but division planes disappeared as quarrying advanced into the hill. One-third mile below Skimmers Eddy where rocks rise in a cliff 400 feet above the river there was a quarry in bluish-green sandstone in layers 3 to 5 inches thick.

At Black Walnut the Wyoming Stone Company was then shipping large quantities of building stone from a quarry $\frac{1}{3}$ mile north from the station and 90 feet above it. They also produced sills, stepping stones, and flags. Two miles below Black Walnut another quarry made a similar output. Half a mile north of Meshoppen on Little Meshoppen Creek were great quarries in massive bluish-gray sandstone 45 feet thick that came off in courses 6 inches to 4 feet thick. This fine, even-grained sandstone was sawed and finished in a stone yard at Meshoppen.

Two quarries had been opened along the river west of Tunkhannock in Tunkhannock Township, and flagstone was extensively quarried at

Nicholson where greenish-gray sandstone split in layers 2 to 4 inches thick and with a very smooth surface.

In 1922 I passed through Nicholson and noted old quarries in the west bank of Tunkhannock Creek that had not been worked for years. At that time, Horace Ruger was getting out flagging in the steep slope above the railroad at the east end of Skinners Eddy. The big quarry at Black Walnut was idle, five small flagstone quarries were operating on the ridge west of Tuscarora Creek north of Laceyville, and the Cole quarry 1.7 miles west of Meshoppen was employing five men to raise flagstone.



Fig. 157. Stone yard of B. Ridgway & Son, Meshoppen, Wyoming County, showing heavy stock and flagstone tile. Photo. furnished by company.

The stone yard of B. Ridgway & Son, at Meshoppen is the market for much of the stone produced in this region. Flags produced at the quarries may be shipped from the nearest railroad station, or they may be taken to the stone yard to be worked into dimensions for stone-paved floors, tile, curbing, stair treads, etc. Some flags and tile are sold with the natural surface, some are planed smooth, and for special purposes a rubbed finish may be given. In former years flagging was used very largely for sidewalks, but now a market is found in floors of college buildings, public museums, county and state offices, etc. Bluestone from this vicinity will be found in floors at Michigan, Brown, Cornell, and Princeton Universities, Philadelphia Museum of Art, and State Capitol, Lincoln, Nebraska.

In 1931 this company furnished rubbed flagstones cut to pattern from architect's blueprints for the floor of the chapel at Duke University in North Carolina, and also prepared a specially designed flagstone floor for the new Community Hall at Hershey, Pennsylvania.

The thin-bedded sandstone of Catskill age in northeastern Pennsylvania that has been employed extensively for sidewalks is known as

bluestone because much of it has a slightly bluish tinge. Some of it is greenish-gray and some is faintly purple. The difference in color is enough so that floors can be laid in patterns, which may be worked out in flags cut in many different shapes. Selection and cutting of flagstone for pattern floors is done at the Meshoppen stone yard.

Heavy flags or stones more than 6 inches thick are prepared also for curbing, stairs, and platforms. Four staircases in the new State capitol at Lincoln, Nebraska were built entirely of sandstone quarried in Wyoming County and prepared at Meshoppen. All treads and



Fig. 158. Stone yard of B. Ridgway & Son, Meshoppen, Wyoming County. Stock of flagstone and shop for dressing stone.

landings were finished on all sides because they are supported only on the ends and edges and the underside is exposed. The landings in these staircases are of rubbed bluestone in blocks 9 feet square and 7 inches thick, each weighing about $3\frac{1}{2}$ tons. The shipment was carried on 20 freight cars.

In 1928 the large quarry at Black Walnut was operated by B. Ridgway & Son. White called it large in 1882. It is reached by following a railroad track up a small valley about half a mile. In this ravine the Catskill sandstone has been quarried along the outcrop for about 250 yards. The original output was largely flags, sills, and curbing, which can be taken from the outcrop where weathering has developed parting planes. Working back from the outcrop the overburden becomes heavy and the planes disappear, leaving the quarry in massive-bedded stone instead of flagstone. So quarrying proceeds along the outcrop.

Earlier operators, to avoid moving so much overburden, did some underground mining by driving a tunnel about 30 feet high. The present operators drilled holes in the overburden and blasted the waste rock into the quarry. The railroad took the waste for fill and riprap but a pile of it partly conceals the old tunnel. Of the rock ledge that rises about 60 feet above the valley bottom, the upper half is so broken by frequent bedding planes and joints as to be worthless for building purposes, but the lower half is very massive. As the beds

are nearly horizontal the flagstone at creek level is well above it a short distance down stream. In September, 1928, three quarrymen and a steam hoist engineer were engaged at the lower end of this long quarry in getting out large blocks. These were of various sizes and thicknesses up to 9 feet square and 1 foot thick. Smaller blocks up to 3 feet thick are sawed to desired sizes at the mill in Meshoppen.



Fig. 159. Bluestone quarry in Catskill sandstone at Black Walnut, Wyoming County, producing heavy stock and flags.



Fig. 160. Heavy stock produced at bluestone quarry, Black Walnut, Wyoming County.

B. Ridgway and Son agree with about 15 quarry operators to take all the good flagstone they produce. These quarries vary in size but all operate in the same general manner, drilling many small holes by hand and splitting the stone with plug and feather. The industry is mostly between Meshoppen and Laceyville on the north side of the river.

I saw no stone buildings in this county. At Tunkhannock, the county seat, a few foundations are of rock faced random ashlar done in bluestone; at Laceyville some retaining walls supporting front lawns are of small flagstone, and many sidewalks and doorsteps in this county are of local bluestone.

YORK COUNTY.

Susquehanna River forms the east boundary and Maryland the south boundary of York County. The area is 903 square miles and the population is 185 per square mile. About 55,000 people live in York, the county seat, which was once the seat of the Continental Congress and capital of the nation. Like all southeastern Pennsylvania it was settled early in the history of the State and some of the pioneers had the energy to build their houses of stone.

The kinds of stone native in the county and used for building include chlorite schist, mica schist, slate, quartzite, limestone, trap, and brownstone. A belt of limestone crosses the county from Wrightsville through York to Hanover. East of this belt the country rock is mostly schist and slate, with here and there a small area of quartzite; west of the limestone red Triassic sandstone and shale predominate, with some large areas of trap west of Conewago Creek, and several square miles of Chickies quartzite west of Wrightsville and Hellam.

Naturally at Delta and Peach Bottom where black roofing slate has been quarried for many years and the waste piles around the pits contain much rubble, this waste material has been used in house foundations, retaining walls, etc. Slate also has been used for flags, curbs, and steps, but not for whole buildings, probably because it is so somber in appearance and hard to dress. This slate occurs only in a narrow belt across Peachbottom Township, and this rock will not be found in buildings elsewhere in the county.

At Castle Fin where the York-Delta road crosses Muddy Creek there is a quarry at the north end of the concrete dam from which stone was taken for use in dam construction and for the power house, built in 1907. This is one of the few examples of the use of chlorite schist for a whole building in this region.

Red Lion, a town of 4,750 named for an old tavern sign, has many brick houses but I saw none of native stone. The bank and Evangelical Church are of granite.

Dallastown, founded in 1736, has one brownstone church, and at the east end of the village a small church made of gneiss, schist, sandstone, and conglomerate, and trimmed with brownstone and a little greenstone. It might be hard to trace the source of this material.

At Hellam and Wrightsville the stone buildings are the native limestone weathered light gray. Much limestone has been quarried here for lime and crushed stone. A layer of impure limestone about 4 feet thick in Steacy-Wilton Company quarry at Wrightsville was worked

for building stone. The office building at the end of the new bridge over Susquehanna River at Wrightsville is greenish-gray Triassic sandstone which was quarried at Bensels Mill.

Numerous varieties of limestone occur in the York Valley. Some are sandy, some shaly, some massive and others thin-bedded. Practically all are crystalline and many of them are medium to coarse-grained marble. From Thomasville to Wrightsville many quarries also contain a limestone conglomerate or breccia, called calico rock. In some places the matrix and the angular blocks are so nearly the same color that the brecciated character would not be noticed on fresh fracture. The fragmental character of the rock is brought out, however, by weathering. Light phases of this rock consist of dull gray fragments in a white matrix, dark phases contain dark bluish gray fragments in a muddy gray matrix. This calico rock is well seen in the quarries of the Palmer Lime and Cement Company, and polished columns of similar stone are in one of the rotundas of the National Capitol at Washington. The rock in these quarries includes light and dark calico marble, and a handsome mottled marble.

The common limestone of the York Valley is generally uniform in color in individual beds, but the beds range from white, gray, and dark bluish-gray to almost black. Polished drill cores from the farm of S. Forry Laucks 2 miles north of York show some white marble but more is irregularly mottled in various shades of gray. Because of the tilting and compression to which the stone in this belt has been subjected, joint planes are numerous and irregular and it is difficult to get out regular building blocks. Nevertheless a number of buildings and many foundations in the valley are built of native limestone.

White marble from the quarries near York has been used for building stone; some of it has been dressed to regular blocks but most has been laid in the wall in the irregular shape in which it came from the



Fig. 161. White marble from York used in the residence of J. W. DeChant, 2106 N. Front Street, Harrisburg.

quarry. The DeChant house at 2601 North Front Street, Harrisburg, built in 1928, is white marble from Lancks' farm 2 miles north of York.

The largest limestone quarry in York County is that of the Thomasville Stone and Lime Company. The quarry face is approximately 1,200 feet long and 60 feet high, and the pit covers several acres. Much of the rock in this quarry is limestone conglomerate or breccia.

Four companies in York quarry dolomite and limestone for building purposes. These are York Stone and Supply Company, Eli Z. Zimm, A. M. Hoke & Company, and C. E. Miller and Son. All stone furnished by them is in rough blocks and dressed on the job, if at all. The Zimm quarry primarily produces crushed stone but suitable material is sorted out for building stone. A hard black stone that breaks in slabby pieces 3 to 4 inches thick with smooth joint faces is used for foundations and backing, and a white limestone that is banded and mottled but breaks in irregular blocks is in demand for house walls. It dresses well and makes a satisfactory building stone.

West of the York Valley limestone belt the common building stone is red or brown Triassic sandstone, except where trap occurs abundantly. In 1926-27 C. M. Hess of Dover, R. D. 4, quarried brownstone on top of Conewago Mountain south of the Wellsville road, taking it from the surface and to a depth of 4 feet. He also gets brownstone flags on the Alex. Hess farm up to 6 feet across. These are used for walks, steps, and fireplaces.

The Triassic sediments which occupy much of the county between York and Yellow Breeches Creek include the common brownstone and also some light tan sandstone. The brownstone was used for the small country churches built a hundred years ago and for occasional farm houses. At Lewisberry, two blocks from the main street is the farm house of Wm. Downs, built of brownstone rubble probably quarried on the place for this stone crops out here. It is coarse-grained but seems to be in excellent condition after more than a century. A tablet in the gable is inscribed "Built by John Felker & Catharine his wife August 25, 1796."

The next farm, on the road to Maytown, owned by Lloyd Fettros, has a stone house, barn, out buildings, and yard walls, all of brownstone. Probably the stone was quarried on the farm. It is all rubble masonry, except for the front of the house, which is coursed ashlar. The house bears a tablet, "Built by Henry Attieh A. D. 1812."

At Wellsville in 1929 a one-story bank building was erected of tan-colored Triassic sandstone quarried by C. M. Hess $\frac{3}{4}$ mile northwest of town in a creek bank. The freshly quarried stone is light and dark tan mixed with gray. The stone in the Hoover residence at Wellsville was taken from the same quarry in 1865. This stone is mostly gray and may indicate how the bank will look in a few decades.

Bensels Mill on Little Conewago Creek $3\frac{1}{2}$ miles northeast of Dover and a 2-story house near by are built of gray Triassic sandstone which was quarried on the creek bank behind the mill. This mill, built by David and Elizabeth Bensel in 1836, is random rough ashlar, of a dark gray tone, in blocks ranging in size up to 10 by 15 by 36 inches. The house, now owned by Peter Elsesser of York, was built about the same time.

In 1930 C. M. Hess of Dover reopened this quarry and provided

the stone for the office building of the bridge company at Wrightsville. The beds dip N. W. about 25° and are in layers from 2 to 20 inches thick, and range from the greenish tone used for the bridge office through gray, speckled, and micaceous, to mottled stone with clay balls and pebbles. Two men were working here in 1931, with bars and mauls only, getting out rough flags and building stone.

The bridge over Conewago Creek near Mount Royal is of local brownstone used rough except the faces of the arches, which are dressed. It was built in 1811, and renewed in 1925.



Fig. 162. Triassic sandstone bridge near Mount Royal, York County.

A house at Rossville and the Memorial school at Wellsville are trap and trimmed with brownstone. Trap boulders were broken up to get this material and as they are weathered, the iron-stained surfaces contrast with the black of fresh fractures.

Newberrytown, named for Newberry Friends who first met there in 1745, has a two-story cigar factory at the east end of the village built of brownstone taken from old stone walls. Several old buildings in Lewisberry (founded in 1734) are of brownstone and as there is no quarry near, it may be assumed that the stone was gathered from the fields. A small church 2 miles east of Lewisberry built in 1811 is of brownstone and the stonework is still in excellent condition.

A brownstone quarry on the Reehling farm $2\frac{1}{2}$ miles west of Goldsboro was opened in 1851, and shipped much stone by rail up and down the Susquehanna for use as base courses, steps, sills, trim, and bridges. In 1880 it was leased by the Hummelstown Brownstone Company, and it has been idle since that date.

In Fairview Township brownstone and trap are used in foundations and fences, but at New Market at the mouth of Yellow Breeches Creek where limestone outcrops in a small area there is an old mill built of



Fig. 163. Church between Lewisberry and Newberrytown, York County, built of brownstone in 1811.



Fig. 164. Chickies quartzite in Grace Methodist Episcopal Church, York.

local limestone. The durability of the limestone and the even weathering to a light gray here demonstrate the suitability of this stone for building.

The Chickies quartzite is a hard tough rock predominantly a very light buff tinged with red and with some joint faces stained dark brown, or it is a whitish rock. The largest area is a triangle between the river, Codorus Creek, and York Valley. A narrow band and several small patches occur south of York Valley. I do not know of a regular quarry in this quartzite, but in 1925 the Grace Methodist Church on Lincoln Highway in the west part of York, was built of Chickies quartzite obtained near Moses Mummert School. This locality is about 2 miles west of Spring Grove and 11 miles southwest of York. I have not visited it but understand the surface rocks were used and very little quarrying was done in bed rock. The stone mason on this job, E. J. Albright, could have produced a rather characterless effect by trimming all stone clean, but he wisely exposed weathered surfaces, including here and there a deep brown spot, and so obtained a pleasing effect. The walls are random ashlar rock-faced, and small blocks mostly less than 1 foot long and 2 to 6 inches thick.

According to Merrill¹ diabase from a quarry at York Haven was used by the Northern Central Railroad in the construction of bridges and culverts. This is now the Baltimore Division of the Pennsylvania Railroad.

York seems to have comparatively few stone buildings, the city being built very largely of brick. The stone buildings that were standing when the Continental Congress met there in 1777 and York became the capitol of the Nation for a day have either been demolished or the masonry is now covered with stucco.

Several houses, shops and other buildings are of the local gray limestone. White marble from the York quarries has been used rarely for porches and lawn retaining walls; if for a whole building I did not see it.

Several banks, including the York County National and First National, are faced with Indiana limestone on a granite base. The York Water Company building (1929) on East Market Street has a front of blue-streaked white Georgia marble. The First Methodist church (1925) on East Market Street is mica schist from the Philadelphia district. The Union Evangelical Lutheran church (1927) on West Market Street is built of seam-face granite from Plymouth, Mass., and trimmed with cast stone. Gethsemane Hall looks like gneiss from Port Deposit, Md.

LIST OF PRODUCERS

The following lists are the names of producers who do or can quarry for building purposes the stone under which the name appears. The lists are incomplete and transitory.

SANDSTONE

Wm. Burke	Altoona.
J. S. Heverly	Altoona.
Stormer & Son	Altoona.
Tom Wason	Butler.
Penna. Sandstone Corp.	Curwensville.
The Charles Contracting Company	Curwensville
C. M. Hess, R. D. 4	Dover.
Conemaugh Stone Company	Dysart.
Ellwood Stone Company	Ellwood City.

¹ Merrill, G. P., *Stones for building and decoration*: 3rd. ed., p. 112, 1903.

Wurtenburg Stone Quarry Company ..	Ellwood City.
Falls Creek Sand & Stone Company ...	Falls Creek.
White Rock Silica Co.	Greenville.
Rockville Quarries Company	Harrisburg.
White Haven Stone Products Company .	Hazleton.
Joseph H. Lennington	Langhorne.
E. M. & Luther Ridge	Langhorne.
Willard White	Lansdale.
W. B. Martin Company, 710 Chamber of Commerce Bldg.	Pittsburgh.
John Genzler	Sanatoga.
Joe Godina, Hyde Park	Seranton.
Peter Stipp & Sons	Seranton.
George W. Miller	Somerset.
Horace Groman	Souderton.
The Brick & Stone Company	Waynesburg.
White Haven Quarry Company	White Haven.
Wm. B. DeLaney, Jr.	Wilkes-Barre.
George Myers	Williamsport.
C. T. Eastburn	Yardley.

FLAGSTONE (BLUESTONE)

James M. Decker	Alford.
John H. Bowen	Aldenville.
C. M. Branthoover, R. D. 2	Belleverson.
Joseph Winans	Dimock.
Croon & Company	Hawley.
George C. Finn	Hopbottom.
Stephen Millard	Hopbottom.
Johnson & Rhodes Bluestone Company .	Horton, N. Y.
Crompton & Hull	Kingsley.
Frank Holdren	Laceyville.
Earl Hendrickson	Lanesboro.
Holdren & Manning	Lawton.
Corey & Hay, Auburn Center	Meshoppen.
Degnan & Winans, Auburn Center	Meshoppeu.
LeRaysville Stone Company	Nicholson.
Ed McCloe	Nicholson.
George Pratt	Nicholson.
Paul W. Bounds Company, Whitaker Avenue & Sanger Street	Philadelphia.
J. D. Emack Company, 1700 Sansom Street	Philadelphia.
B. Ridgway & Son, 4300 Clarissa Street	Philadelphia.
J. G. Robinson Stone Company, Ritten- house & Pulaski Street, Germantown .	Philadelphia.
A. H. Woodward & Company	Pond Eddy.
Gust Johnson	Sinnamahoning.
Tom Bates	Slate Run.
Gus & Frank Bennett	Slate Run.
M. E. Callahan	Slate Run.
Walter Campbell	Slate Run.
Isaac Fisk	Slate Run.
John Morgan	Slate Run.
Grant H. Tomb	Slate Run.
Alfred Buchanan & Son	Stevens Point.
Dick Bailey	Stevens Point.
Miles Finch	Stevens Point.
Nason Hobart & Son	Stevens Point.
Wheeler & Whittock	Stevens Point.
Tom McCloe	Summerville.
J. Johnson & Daniel Pond	Terrytown.
R. G. Bonnell	Waterville.
J. L. Woodruff, Durrell	Wysox.

QUARTZITE FOR BUILDING STONE

Joseph Rotunno	Avondale.
Wm. N. Woorall	Avondale.
W. B. Castle	Broad Axe.
Edward Wirth	Downingtown.
Hoofer & Decmer	Hellertown.
W. B. Aierstuck	Lancaster.
H. L. McLimans	West Grove.

GRANITE, GNEISS AND SCHIST

Walker Granite Company	Alburtis.
P. J. Lawler	Bala.
McCabe Brothers, 12 Chestnut Avenue .	Bala.
Bethayres Quarry Company	Bethayres.
W. A. Hayden	Broomall.
C. De Felice, 24 Merion Ave.	Bryn Mawr.
Anthony Mignone & Sons	Byberry.
D. F. Green, 1119 Edgemont Avenue ..	Chester.
Antonio S. Roman, Waverly Quarry ...	Chestnut Hill.
A. Sngerman & Sons	Devault.
Charles A. Evans	Drexel Hill.
James Maher	Drexel Hill.
George M. Burnley	Garrettford.
August Magnatti	Elkins Park.
John Mercario, 72 E. Shartnack St. ...	Germantown.
General Crushed Stone Company	Glen Mills.
Holmesburg Concrete Company, Welsh Road	Holmesburg.
Marcolina Brothers	Jenkintown.
A. Vechione	Jenkintown.
Roman & Felix	Jenkintown.
Angelo Nesci	Lima.
Vincenzo Di Francesco	Llanerch.
James Logue	Llanerch.
Raffaell Crispo	Media.
J. W. Hibberd	Media.
John Randazzo	Media.
Chestnut Hill Contracting and Gray Stone Quarry Company, 7811 German- town Road	Philadelphia.
A. C. Emlen, Washington & Stanton Aves., Germantown	Philadelphia.
John De Filipo, 2935 Van Pelt Street .	Philadelphia.
J. W. Fowler, 103 W. Horter St., Ger- mantown	Philadelphia.
Butte & Orlando	Philadelphia.
R. W. McConnell, 4506 Regent Street ..	Philadelphia.
Walter Harper	Ridley Park.
Massino Bros., Springfield	Philadelphia.
D. D. Porta, Springfield	Philadelphia.
C. I. Leiper Estate	Swarthmore.
D. L. Sloan	Upper Darby.
C. A. Alexander	Wayne.
Wm. McClellan	Wayne.
Smith Brothers	West Manayunk.
Thos. P. Lee, 5629 Cherry Street	West Philadelphia.
Paolucci Caniello & J. A. Juliano, 214 N. 62d Street	West Philadelphia.
Charles T. Eastburn	Yardley.

DIABASE, TRAP (BLACK GRANITE)

E. W. Bradford & Son	Coopersburg.
Coopersburg Granite Company	Coopersburg.
Gibraltar Black Granite Corp.	Coopersburg.
Emory Rosensteel	Gettysburg.
C. W. Zeigler & Company	Gettysburg.
Black Diamond Granite Corporation ...	Quakertown.
General Crushed Stone Company	Quakertown.
French Creek Granite Company	Saint Peters.

LIMESTONE FOR BUILDING STONE

H. E. Millard	Annville.
Samuel Given	Berwyn.
Bethlehem Mines Corporation	Bethlehem.
Baker Stone Company	Bloomsburg.
C. D. Felice, 24 Merion Avenue	Bryn Mawr.
Hempt Brothers	Camp Hill.
J. F. Sours	Carlisle.
John S. Brumbaugh	Chambersburg.
Augustus Wolf & Company	Chambersburg.
Edward Wirth	Downingtown.

Binkley & Ober	East Petersburg.
John Waltz, S. Delaware Drive	Easton.
S. B. Keller	Ephrata.
Harry T. Goetz	Greencastle.
Westmoreland Bluestone Company	Greensburg.
Hoffman Brothers & Wilson	Harrisburg.
Bonnymeads Farms	Harrisburg.
Walter C. Hocker	Highspire.
Mapleton Limestone Company	Huntingdon.
J. M. Brenner	Lancaster.
Walter B. Kendig	Lancaster.
Calcite Quarries Company	Lebanon.
Russell Guyer, Dickey Station	Mercersburg.
Bitting & Francis	Mt. Penn.
Frank D. Barnhart	Mt. Pleasant.
New Enterprise Stone & Lime Company.	New Enterprise.
Michael G. Garber, Box 313	Norristown.
Standard Cement Products Company ...	Palmyra.
Warner Company, 1616 Walnut Street..	Philadelphia.
Booth & Flinn, 1942 Forbes Street	Pittsburgh.
A. H. Burkholder	Quarryville.
Fehr & O'Rourke Stone Company	Reading.
Fisher Brothers	Ronks.
A. B. Horst	Schaefferstown.
Oak Hall Lime & Stone Company	State College.
Stacey & Wilton Company	Wrightsville.
A. M. Hoke & Company	York.
C. E. Miller & Son	York.
York Stone and Supply Company	York.
Eli Z. Zinn	York.

MARBLE

Lukens & Yerkes, Stephen-Girard Build- ing	Philadelphia.
H. L. McLimans	West Grove.

SERICITE

Frank Ciocca	Edge Hill.
Edge Hill Stone & Construction Com- pany	North Glenside.
Wm. T. B. Roberts & Son	Welden.

BLACK PHYLLITE

A. H. Fell	Danborough
E. A. Groff	Harleysville.
Landis Stone Company	Mainland.
A. R. Shaffer	Mountville.
E. G. Hoyler	Perkasie.
E. E. Derstine	Souderton.

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